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# AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.
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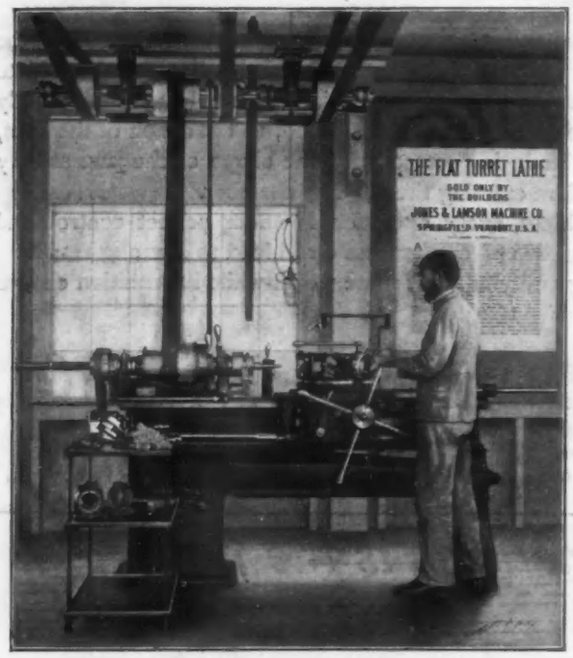
Contents and Index to Advertisers, Page 8.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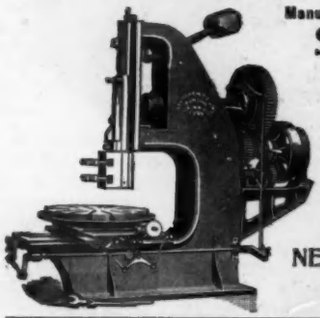

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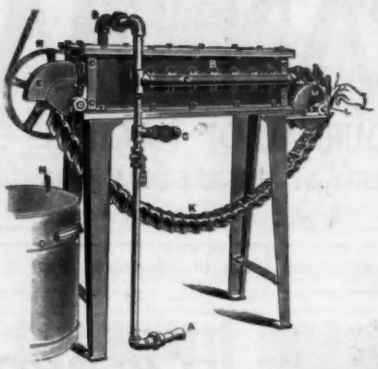

may not have the slightest interest for you, but we show a machine that we designed for that purpose, simply to illustrate the point that we devise and build hardening and tempering machines for all sorts of special uses—machines that not only do the work better than it was ever done by any other method, but that very greatly reduce the cost of such work, at the same time.

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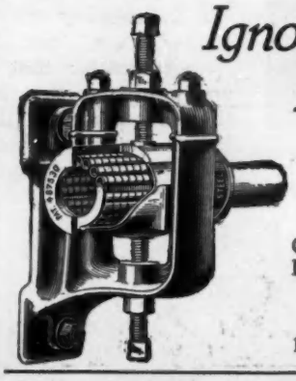

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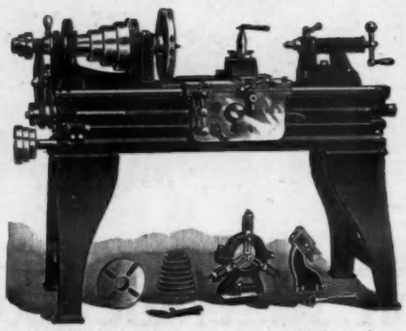

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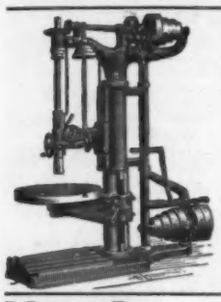

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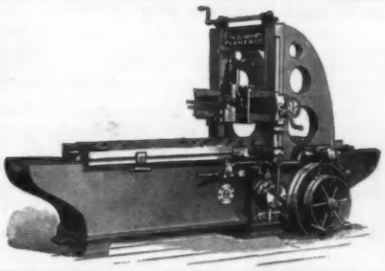

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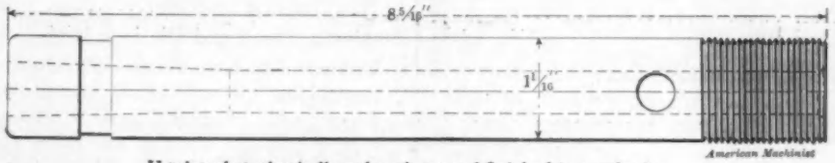


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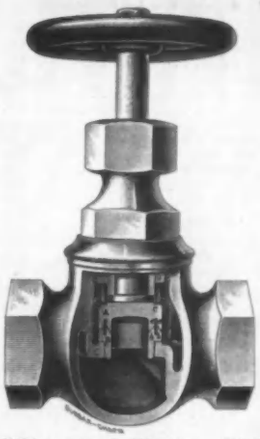

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# AMERICAN MACHINIST

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## The Production of Precision Machinery.

The article in another column on the precision lathe constructed for Professor Rogers describes what was, from the precision standpoint, undoubtedly one of the finest pieces of mechanism ever constructed. It was, moreover, constructed in the belief that it could be made to pay in a commercial sense, i. e., that there was sufficient demand for screws of the highest possible grade for use in instruments of various kinds to provide profitable employment for such a tool. As related in the article, the lathe was unfortunately destroyed by fire while still new, and not long afterwards, Professor Rogers died, a combination of disasters which necessitated the abandonment of the enterprise.

The machine was in existence long enough, however, to demonstrate that there is a real need for screws of the grade which it was intended to make, though this is not saying that the demand was sufficient to make the enterprise a profitable one in the commercial sense, or that those needing such screws could or would pay the prices necessary for such screws when made on a commercial basis.

For ourselves, we are convinced that, except in a few lines where the demand happens to be sufficient, work of this grade cannot be done commercially, and that attempts to do it, in which technical success is attained, will be sporadic only, and without much influence or value to the world at large. Like scientific research of all kinds, such work must be supported by funds other than those derived from the sale of its products, and such work is just as worthy of support by public-spirited men of large means as any other line of research. Indeed, considering the degree of precision now required in instruments for scientific research in all fields, it is our belief that the maintenance of such a shop would do more for the direct advancement of pure science than the same amount of money could be made to do on any other plan of investment. Moreover, such a shop would do more to advance the name and reputation of American mechanics than any amount of commercial work. It is never to be forgotten that it is work of this character which is talked about. The influence of Alvan Clark in making American mechanics respected is simply incalculable. The Lick and Yerkes telescopes have probably received more public attention than any other two recent mechanical constructions, while among European scientists, it is probable that the shop of Mr. Brashear is better known than any other in this country. The influence of the example of work of this class is, too, of great importance. Such a shop, centrally located, would soon become a Mecca to all mechanics, and its influence would react upon all the mechanical interests of the country.

Is it too much to hope that some of our public-spirited men of means, who are looking for an opportunity to use some of their surplus wealth for the good of the community, will see the futility of duplicating existing educational facilities, and, instead of adding to our already sufficient number of educational institutions, will endow a precision machine shop? No more worthy object could be found, and to one who has amassed wealth in industrial enterprise it would seem that no more attractive or appropriate public benefaction could be named. No reasonable addition to existing educational institutions would do so much to advance either science or education, while the amount required in comparison with the endowment of a college or university is so small as to make the project particularly attractive. We believe there is no other existing opportunity for a public benefaction from which so much real service to science and education could be obtained for less than ten times the outlay required for this. Moreover, the time is opportune. The pioneer work has been done and the ground has been broken, and in doing it available workmen have been trained, who could take up the work and carry it on to a successful issue with a minimum expenditure of time and money.

Is there no American millionaire who will obtain lasting credit for generosity and good sense, by endowing a precision machine shop?

## The Electrical Exhibition at Madison Square Garden.

All exhibitions are alike, and to this rule the present one is no exception. By this we mean that most of the exhibits in such a show are familiar objects, the number of novelties being comparatjvely few.

Perhaps the most striking single feature of this show is the automobile, which is shown by several exhibitors. A great variety of forms of carriage is shown, though all are electrically driven.

In point of novelty the most interesting exhibit is that of the radiophone, by which sound is transmitted through the agency of a beam of light. A search light at one side of the hall throws a beam to a parabolic reflector at the opposite side. Through telephonic apparatus the sound of a cornet is transmitted through this beam of light to the ear of the observer, who is located in a sound-proof telephone booth, enclosing the reflector. The announcements lead one to expect the transmission of speech, but this is not accomplished in fact. This exhibit is, we believe, the first to show this apparatus in this country. Akin to it in interest though not in method of action, is the exhibit of wireless telegraphy, which is much better shown than last year, while it is presided over by a gentleman who has not yet grown weary of the ceaseless explanations called for—or at any rate, he shows no signs of weariness. Last year the transmitter and receiver were located in the gallery and at the opposite sides of the hall, necessitating some effort to obtain an idea of the apparatus as a whole. This year they are close together and are conveniently arranged for observation.

The X-rays have lost none of their popular interest, and the booth for their

exhibition has a long line of people waiting to get a glimpse of their own bones.

Some very interesting exhibits are supplied by different departments of the Government. A complete equipment for field telegraphy, as used by the army signal corps, is shown. Of this the most notable single feature is the telegraph wagon, which contains a complete telegraph office on wheels, together with a supply of wire and poles used. Some older types of apparatus are also shown to illustrate the practice when the work of the signal corps was in its infancy. Some of the apparatus shown is historical, having been used at Santiago. Some of the features of the electrical equipment of the ships of the navy are also shown, these including the method of transmitting orders to the gun crews and to the officer at the helm by sight instead of sound, and of signaling from ship to ship. The development of electric communication in military operations began, we believe, with the civil war, and the use of electrical methods of communication on shipboard is, we believe, largely original with the American navy. The searchlights of the Maine and of the Vizcaya are shown as relics of the late unpleasantness.

To the non-technical visitor perhaps the most interesting exhibit is that of submarine diving. A tank with glass front is used, the diver—a woman, by the way—descending into the water in a full diver's suit and going through a program of exercises. The suit contains several new features, chief of which is a telephone, by which communication with the surface is had. This telephone takes the place of the old signal rope by which a certain number of signals could be sent up or down. Submarine diving is a business of which the general public has so little means of learning that the exhibitions are well patronized, as they deserve to be.

From a purely scientific standpoint, the Wehnelt interrupter is perhaps the most interesting exhibit. This is shown in connection with a Ruhmkorff coil, and produces miniature lightning in abundance. The interrupter nearly doubles the power of the coil, as regards the length of the spark, though the reason for this action is somewhat obscure. In connection with this exhibit a powerful Holtz machine is shown, which is said to produce a tension of 500,000 volts.

In machine shop applications of electricity the principal exhibit is by the Bullock Electric Company, who show several machine tools fitted with their multiple voltage system of control, by which regulation of speed between wide limits is obtained.

Some exhibits called for by the catalogue were not to be found at the time of our representative's call. Among these are the Nernst lamp and liquid air. As a paying attraction the authorities could do no better than to get the latter on view without delay. From either a scientific or a popular point of view, no achievement of recent years is more attractive or important.

The show will be seen to contain many interesting things, and it is being well patronized. In this respect, however, it does not equal the first exhibition held in the Grand Central Palace in 1896, which was probably the most successful special exhibition ever held. The then newly discovered X-rays and the widespread interest in the discovery, the arrival of the Niagara Falls Electrical plant to the point of application, and the transmission of electrical power from it to the exhibition, and the fact that the exhibition was the first of its kind to be held in this city, formed a combination of favorable circumstances which in the nature of the case can never be duplicated, and may never be equalled. This show, however, contains as much, if not more, of real interest, and were the drawing powers of liquid air properly utilized we believe the attendance would be greatly increased.

## For a Monument to Robert Fulton.

The body of Robert Fulton lies in the vault of the Livingston family in Trinity churchyard, and to this day no suitable monument has been erected there to his memory. At the recent meeting of the American Society of Mechanical Engineers in Washington the matter was brought to the attention of the council of the society, and a committee, consisting of three members of the council, was appointed to investigate the matter and to suggest suitable action. The Livingston vault is south of Trinity Church and near Church street, and is covered by a plain brown slab. There is a silver plate on the Fulton casket, giving dates of birth and death, and on the wall of the vault is a tablet containing a list of all interred there, which is at present the sole record in the churchyard. It would be eminently proper for the American Society of Mechanical Engineers to be the means of securing a suitable and enduring monument to the epoch-making inventor.

## The Unique Mechanical Engineers.

The following interesting notice of the American Society of Mechanical Engineers, on the occasion of their recent meeting in Washington, is from the Washington "News-Letter:

"This society met the past week in national convention in this city, members from the various States of the Union, Canada, Great Britain, France and other foreign countries being present. The members of this society are not a representative body, each one being for himself, as they are of such high grade that few can be found in any one place. Andrew Carnegie, George Westinghouse, Chief Engineer Melville of the United States Navy (president), F. R. Hutton, professor of engineering of Columbia College (secretary), and Professor Thurston of Cornell University, are now members; and, taking the body as a whole, there is nothing like it on earth, as its members of all countries represent the leading men of mechanical thought in all of its branches. The great improvements in steam and electrical engineering for the past fifty years are due largely to members of this society.

## Right Names of German Towns.

Let me suggest that exporters (and consuls) call German towns by their only right names, which are the German ones. There is no town of "Aix-la-Chapelle" in Germany; the name is "Aachen." There is no "Ratisbon," but a "Regensburg," so called because it is on the river Regen. Similarly we should say and write "Köln," which is the German, and not "Cologne," which is not even English, but French.

The Bohemians are not by any means pleased when we write "Prague." The name of the town is "Praha," and the majority of the inhabitants are fussy about it. If I should try to sell goods to Mr. Carpenter and insist on calling him "Zimmermann" he might not like it; why then should I call Zimmermann "Carpenter" or Aachen "Aix-la-Chapelle?"—Robert Grimshaw in "American Trade."

## Modern Railway Equipment.

The Central Railroad of New Jersey is scrapping many locomotives and cars of old pattern and replacing them with modern equipment. The development of engines and cars is well illustrated by the difference between the old and new. The whole fifty-two locomotives last scrapped had less combined tractive power than fifteen new ones put into service. Fourteen thousand four-wheeled coal cars are being destroped, and 2,500 new American gondolas put into their places. The 2,500 will carry more coal than the 14,000 old cars.

We learn from the Nicholson File Company that the "File Filosophy," notice of which was made in these columns upon its publication two months ago, has proved so popular that a second and much increased edition is rendered necessary. The little book has been sent to thousands of machinists and file users throughout this country and abroad. Treating, as it does, of files and how to use them, it proves invaluable to anyone interested in that class of tools. They may be had free upon application to the company's head office in Providence, R. I.

One of the difficulties encountered by British trade unions is said to arise from the inclination of some of the members to avoid becoming employed when men are in demand. By keeping out of employment they draw out-of-work benefits from their unions, and to deal properly with them seems to be a problem.

# Commercial Review.

NEW YORK, Saturday Evening, May 20, 1899.

SMALL TOOLS AND SUPPLIES.

Conditions still denote intense activity and are little changed from last month. Many dealers report no decrease in sales as the spring progresses. Others see a slight tapering off, which is not surprising. It is possible that in the aggregate March slightly outdid both this month and last, yet all three have been superlatively fine months. Much difficulty is experienced by dealers in getting goods from factory within a reasonable time. Stocks are much broken in upon. A power transmitting machinery seller professes satisfaction in the multiplicity of small orders from stock, rather than the receipt of contracts for complete installations, since the former are most easily filled.

The proposed consolidation of file manufacturers is stated by an inside authority to have practically been dropped, owing to the unwillingness of one or more makers to come to reasonable terms. The largest manufacturers seem generally to have been in favor of the project, however. Negotiations had proceeded so far that a certain party who has the matter in charge secured options on several plants.

It is proposed shortly to advance the price of one of the leading makes of imported files.

A wood pulley company claims that it has advanced prices 10 per cent. and that other leading manufacturers have done the same, but elsewhere it is denied that higher prices prevail. There are at present two price lists in the market, and it is said that at a meeting of wood pulley interests to be held next month a uniform list may be adopted. This will not necessarily mean higher prices, but perhaps the contrary.

Proposals to furnish supplies to the Washington Navy Yard were opened May 16. The lowest bid on a lot of twist drills, amounting to $1,010.37, was put in by the Fairbanks Company, N. Y. Patterson, Gottfried & Hunter, New York, made the lowest offer on hand taps, etc., $267.39. Some of the bids on drills are stated by a dealer to be below the price agreed upon by the combination, but this is explained as due to the existence of old contracts between bidder and manufacturer.

A member of the firm of Charles A. Schieren & Company, leather belting manufacturers, informs us that they experience no diminution in demand as the season advances. The extensive operations in progress in iron and other lines keep the market continually active. During the depression people were inclined to patch up their old belts and make them last as long as possible; in consequence they are now putting in new ones extensively. Export trade is increasing, particularly that with Russia and with the Far East, including Japan. The manufacturers of belting have held a meeting and agreed upon a 15 per cent. advance in prices. There is renewed talk of a consolidation of belting manufacturers, but the probability of its realization is discredited.

A miscellaneous supply dealer reports an exceptionally good export demand for bicycle parts, particularly for shipment to Paris.

The managing member of a well-known New York small tool and supply firm observes a decrease in foreign trade as a result of higher prices. Last year the firm were sending abroad a great deal of pipe, but now the shipments have fallen off. Last year pipe could be delivered in Russia and Switzerland cheaper from this country than from England or Germany, but now the monetary odds have turned against us and the results are manifest. The same man states that he knows of cases in which English machine tools have been purchased abroad instead of American because of increased prices of the latter.

One of the proprietors of a leading line of files, the introduction of which abroad has proceeded with success and satisfaction in the last year or two, states now that there is so much domestic trade that he cares little about foreign, and is making little attempt to solicit it.

MISCELLANEOUS.

Among many orders for electric traveling cranes recently received by the Case Manufacturing Company, Columbus, Ohio, are the following: Moran Brothers Company, Seattle, Wash., one 25-ton crane; Long & Allstatter Company, Hamilton Ohio, two 25-ton; Farrell Foundry & Machine Company, Ansonia, Conn., one 15-ton; Erie City Iron Works, Erie, Pa., one 25-ton; Missouri Railroad Company, St. Louis, Mo., two 75-ton; Canton Roll & Machine Company, Canton, Ohio, one 15-ton. A 60-ton crane has lately been installed for the Burgess Steel & Iron Works, Portsmouth, Ohio, and a 30-ton for the American Steel Foundry Company, St. Louis, Mo.

The Dodge Manufacturing Company has lately received an order for about $40,000 worth of log rollers for loading logs on cars. It has also recently contracted to equip a cement mill in the West and a paper mill. The company continues, as it has been for a long time past, crowded with work to fullest capacity.

Two machine tool sellers on Liberty street, from whom inquiries were made yesterday, both report trade splendid. One of them who recently estimated deliveries on heavy tools to average three months now considers four months a more representative figure. Some orders are on hand for exceptionally large tools, which cannot be delivered within eighteen months. A good demand is noted for equipments of small shops which require ten or twelve medium-sized tools, to the value of two or three thousand dollars.

Advices from Cincinnati to a local party are to the effect that labor troubles in tool manufactories are coming to the fore there as well as in the Eastern States. Higher wages and shorter hours are said to be the bones of contention.

A contract for a condensing plant, to be used by the Belfast (Ireland) Electric Power Company, has been received by the Wheeler Condensing & Engineering Company.

CHICAGO MACHINERY MARKET.

One notable instance in which industrial activity is broadening out is in electroplating. For four or five years and up to a year ago the chief element of trade in plating supplies was with the bicycle makers. With the massing of bicycle production into fewer hands the electroplating business experienced some decline. Quite recently, however, inquiries have vastly improved, and while orders based on those inquiries are not what they should be, the situation is greatly improved over what it had been. It is an index of the revived industrial activity. Manufacturers who had been listless or inactive because of an unresponsive environment are now wide awake to new methods and are reaching out tentatively in various directions. Many plants that have heretofore been having their electroplating done by outside people are figuring on adding that department to their works, and quite a number of new processes have been springing up to fill the current of trade with new life. Thus, a new method of plating steel wire continuously in the process of manufacture is interesting the wire trade. A lately devised process for removing the surplus spelter from brazed bicycle frames instantaneously is equally interesting to the bicycle trade. There are other lines of advancement which cannot yet be announced, but which will soon give to this line of industrial supply renewed vigor. The Hanson & Van Winkle Company reports that its trade in this city in electro-plating supplies during the past month has greatly improved, the number of new and unexpected inquiries for outfits being especially large.

Consumption of machine shop supplies is of a volume that is most gratifying. Careful inquiry leads to the conclusion that the shop activity in the West is fully as great in May as in March and April. These are the three banner months in the history of the trade. Statements from conservative business men in the line of machinists' supplies are quite common that never in their history have they known a condition of trade quite so favorable as that of the present. Everybody is busy. Everybody seems to be prospering, and collections are unusually good. The agricultural shops see an active trade ahead of them this season and are crowding the capacities of their plants to the utmost, crowding in a little extra machinery, picking up a few more men wherever they can be found, and working

overtime. There are some delays in obtaining supplies. Brass goods are very scarce, and the emery wheel market is not only bare of stocks, but there are delays in some instances of two months before desired sizes can be obtained. It is needless to specialize the goods that are active. Everything that is used in a machine shop is in good demand. Prices are either steady or advancing.

Even as far West as Chicago there are manufacturers who are entirely neglecting the home trade to cater to the foreign business built up in the past few years. They have modified their products somewhat to conform to European standards, and the orders from abroad, they say, are more profitable than the trade they could pick up at home. This refers to finished machines rather than supplies, but the trade generally does not seem to have become accustomed to this new state of affairs.

On a single day of this month the Chicago Pneumatic Tool Company booked at the home office mail orders for eighty-one pneumatic hammers and riveters; fifty-seven drills of various sizes, and seventeen sundry tools. The company has just received an order for eight pneumatic riveters for Shanghai, China. It has sent quite a number of tools to that country in the last year or two.

## Quotations.

NEW YORK, Monday, May 22.

Iron — American pig, tidewater delivery:—

| | |
|---|---|
| Pennsylvania irons: | |
| No. 1 X foundry | $16 75 @ 17 00 |
| No. 2 X foundry | 16 00 @ 16 25 |
| No. 2 plain | 15 50 @ 15 75 |
| Gray forge | 15 00 @ 15 25 |
| Alabama irons: | |
| No. 1 foundry | 16 00 @ 16 25 |
| No. 2 foundry | 15 75 @ 16 00 |
| No. 3 foundry | 15 25 @ 15 50 |
| No. 1 soft | 16 00 @ 16 25 |
| No. 2 soft | 15 75 @ 16 00 |
| Foundry forge | 14 75 @ 15 00 |

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.50 @ 1.55c., nominally; refined, 1.60c., upward. Store prices: Common, 1.80c.; refined, 1.90c., upward.

Tool Steel — Base Sizes — Standard quality, 6 @ 7c.; extra grades, 12 @ 14c.; special grades, 10c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 2.10 @ 2.20c.

Cold Rolled Steel Shafting—Base Sizes, from store, in small lots, 3.00c.

Copper—Carload lots, Lake Superior ingot, 18½c.; electrolytic, 17½ @ 17¾c.; casting copper, 17 @ 17½c.

Pig Lead—Carload lots, 4.45 @ 4.50c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 25¾ @ 25⅞c., f. o. b. New York.

Spelter—Prime Western, in carload lots, 6¾ @ 7c., New York delivery.

## Professor W. S. Rogers' Precision Lathe.

The Transactions of the American Society of Mechanical Engineers contain several contributions by the late Professor W. S. Rogers, relating to his labors in the production of precision screws. These papers are, unfortunately, written in very obscure language. We doubt very much if anyone not already well acquainted with the methods employed can read the papers understandingly or obtain from them any definite idea of what these methods were. There is, however, no doubt that the results obtained by Prof. Rogers were of remarkable accuracy—probably more so than have been obtained by any other worker in this field, and it seems eminently proper that a more intelligible account than those now in print should be given.

The precision lathe to which this article is devoted was constructed by Messrs. Webber and Philbrick, of Waterville, Me., and Mr. Philbrick having given some information supplementary to that on record in the A. S. M. E. Transactions, the following account of the methods used has been prepared, and is believed to be, in the main, substantially correct. It is a source of lasting regret to all mechanics who are interested in precision work that the lathe here shown was destroyed by fire, and that, Prof. Rogers being now dead, there is no probability of the work being resumed.

The lathe is shown in the half-tone herewith, and will be seen to have been of very massive construction. It was 11 feet in length over all; the depth of the shears was 14 inches, while the thickness of the shears was 2⅝ inches. Its purpose was to cut screws only, and its special features are those by which the errors in its lead screw were first determined and then corrected, or rather compensated, so that the screws cut by it should not reproduce the errors of the lead screw. It was the original intention to first compensate the errors of the first screw so far as possible and then to cut a new screw in the lathe itself, which should be again investigated and compensated as the first one had been —the expectation being, of course, that more accurate results would be obtained from the second screw than from the first. In point of fact, however, this was not done—the screws cut from the first leading screw satisfying all requirements. Indeed, some screws were cut for an instrument for measuring photographs of the heavens, which is now in the observatory of Harvard University, in which no errors could be detected by Professor Rogers himself; the screws being, within the limits of observation, perfect.

The spindle of the lathe will be seen to carry a large wheel which is, in fact, an index wheel, and the accurate subdivision of this wheel furnished the starting point for the investigation of the errors. This wheel was divided into one thousand divisions by the following process. First it was divided into one hundred provisional divisions by means of a paper scale wrapped around it. In this preliminary division the degree of accuracy arrived at was such that in the subsequent work with the microscope the dividing lines should at least fall within the field of the microscope. This accomplished, two microscopes fitted with eyepiece micrometers were mounted at approximately one-tenth of a circumference apart. At the start the investigator concerned himself with the lines dividing the circumference into ten parts only. The first line of division was adjusted to the zero line of the micrometer of the first microscope, and the location of the second line, as shown by the micrometer of the second microscope was read and noted. The circle was next turned until the line previously under the second microscope came exactly under the zero line of the first, and the position of the third line now under the second microscope was read—the spacing of the microscopes being taken as a provisional standard. This process was then repeated until the wheel had been circumscribed—the readings for the position of each line as shown by the micrometer being taken and noted. The readings being summed and divided by 10 gave the reading which would have been observed had the division of the circle been exact—that is, it gave the difference between the true spacing of the divisions and the span of the microscopes, and by comparing this true average reading with the actual readings, the error in the lengths of the divisions may be found. Some of the divisions would naturally be too long and some too short; that is, some of the errors would be plus and some minus; and by algebraic summation from the starting point the error in location of each division may be found, but it may be noted, the wheel being divided into the required number of divisions, the algebraic sum of all the errors is bound to be zero.

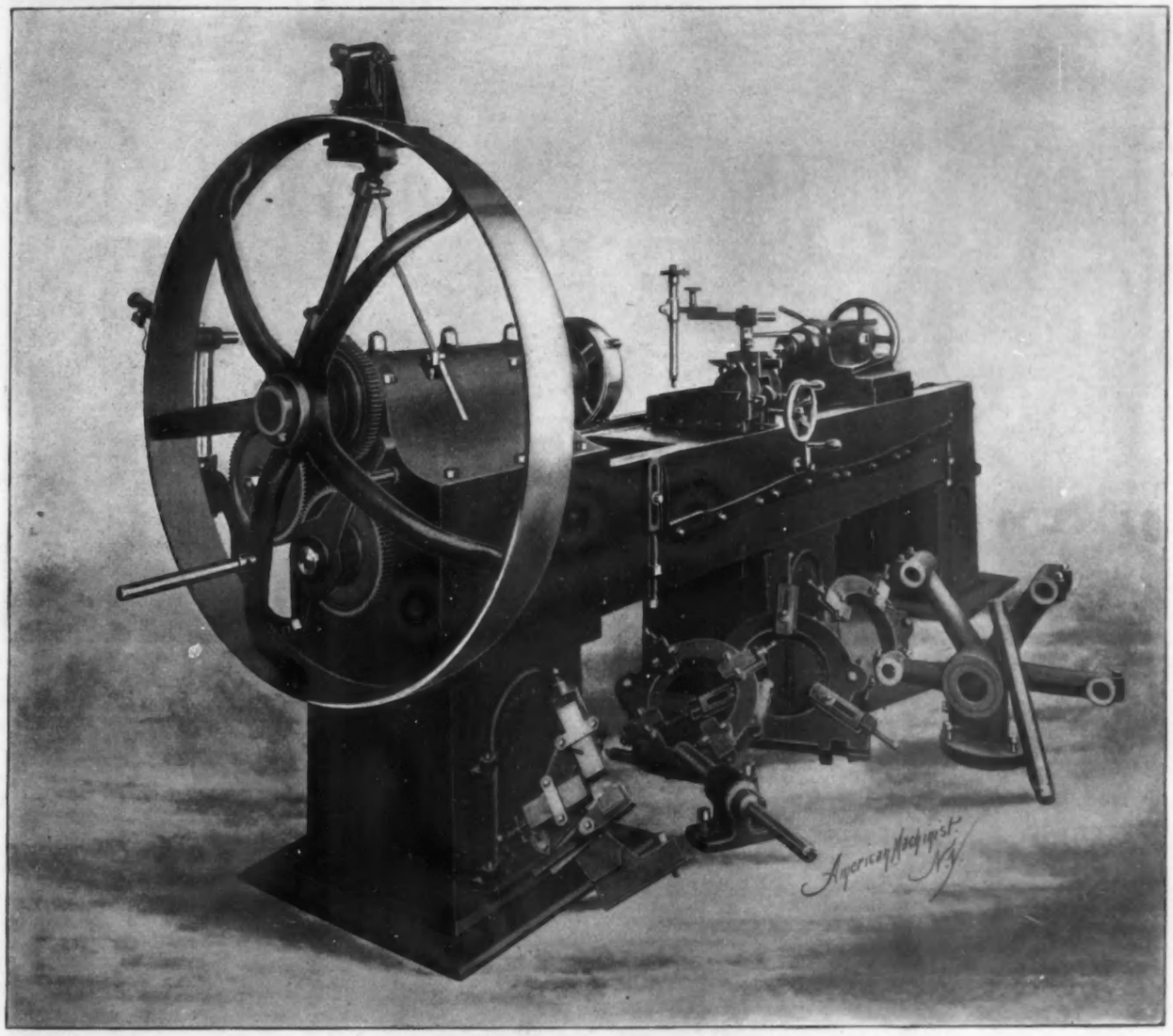
These observations being recorded in tabular form, the next step was to remove one microscope and substitute a diamond-pointed marker for ruling a second set of graduations. This marker, which it is unnecessary to describe in detail, will be seen above the index wheel in the accompanying illustration—the remaining microscope being seen in the rear. Adjusting the first division below the zero of the micrometer a new first line is made with the marker. The second old division line is then brought below the microscope, but set in advance or in rear of the zero of the micrometer by the amount of its error in position as found by consulting the table of errors. In this way a second set of divisions was obtained of far greater accuracy than the first, and by repeating the operation the ultimate accuracy was very

great. The division of the circle into tenths being completed, the same process would divide each tenth into ten subdivisions, and ultimately each subdivision into ten still finer—the total number of divisions in the completed wheel being 1,000. The face of the wheel will be seen to be quite wide, and the successive circles were ruled side by side, the old circles being eventually polished out. The division lines, it should be remarked, were very fine, being quite invisible to the unaided eye.

be seen, and below this is a finely graduated bar. It is well known that means exist for the division of such bars with a high degree of precision; the methods of doing this being unnecessary to describe here. This microscope, like those used in graduating the wheel, contains an eyepiece micrometer, and by bringing a given line of the divided circle to a fixed point and comparing this with the reading of the micrometer, the error of the screw at that point is determined.

A slab-shaped piece of iron will be

It is obvious that as the carriage advances, the lever will rise and fall on this template, turning the nut with it, and thereby hastening or retarding the advance of the carriage, as the case may be. The outline of this template was determined by comparison of the divided circle and microscope readings of the graduated bar. Thus, the divided head being adjusted to a given reading, the correction template lever was adjusted until the carriage was brought to position to give a corresponding reading of the microscope. With




PROFESSOR ROGERS'S PRECISION LATHE.

There is at this point a lack of clearness in Professor Rogers's account of his work. His words read quite clearly that the circle was first divided into 100 parts, and yet he says quite as clearly that the tenths only were treated in the first instance. This does not, however, affect the general method followed.

The circle being correctly graduated, the way was prepared for the investigation of the errors of the screw. Supported by the slide rest of the lathe a microscope will

seen upon the front side of the lathe, and upon this a correction template of irregular outline. The center of curvature of this slab is the center of the lead screw. The nut has no rigid connection with the carriage—being what Professor Rogers called a "free nut," which merely pushes the carriage along. The nut is free to turn about the screw, and has attached to it a crooked lever which reaches over the lathe shear and carries at its end a roller which rides on the correction template.

correspondence in the two readings the position of the roller at the end of the template lever gave a point on the profile of the template, and in the same manner other points on this profile could be obtained. Of course it is not to be expected that a correct profile would be obtained at the first trial, the process described being properly a first approximation, to be corrected and re-corrected by repeated trial.

It will be observed that the gears con-

necting the live spindle and the lead screw were of the same size. They were also so marked as to insure being so placed in mesh that the same teeth would always engage. This being attended to, it will be seen that the correction of the screw already described would also compensate the gear errors.

The lathe has several special features, some of which may be seen in the illustration. Thus, the tail stock is universally adjustable, not only bodily, but angularly as well. The tool will be seen to be placed in a socket which is mechanically fitted sideways, permitting the tool to be removed and replaced without disturbing its adjustment. Several of these sockets for different tools were of course provided. The side-rest drops into ledges on the shears, but is guided by the front one only—shoes in sockets and backed up by springs keeping the work always in contact with this side.

The cutting of a precision screw even with a special lathe like this is of course a slow process. One such screw of considerable length which was cut on this machine occupied a full month. This was, however, largely due to the care used to avoid the effects of the heat generated in the operation of cutting. Toward the close of the work, but one chip a day was removed, the wait between chips being intended to give the heat generated by the cut ample time to dissipate itself.

Several attachments will be seen in the foreground, some of which are for obvious and familiar purposes. The follow rest nearest the observer will be seen to be provided with an adjustable shoe below the work, which was provided in order to take the weight of the screw and prevent sagging at the cutting point. The star-shaped piece with the screw leaning against it was for some purpose now unknown.

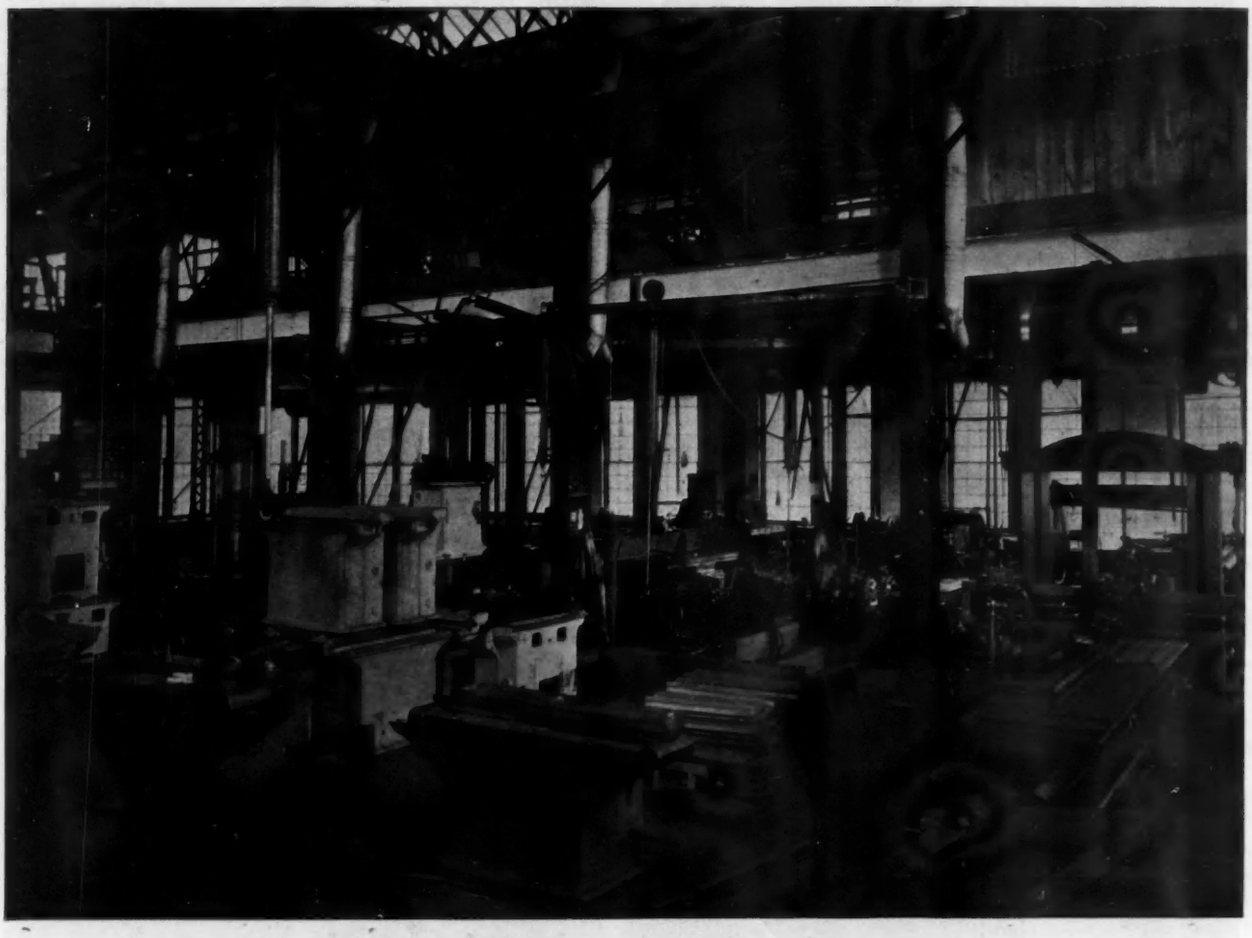


FIG. 13. PORTION OF ERECTING FLOOR AND GALLERY. LANDIS TOOL COMPANY'S SHOPS.

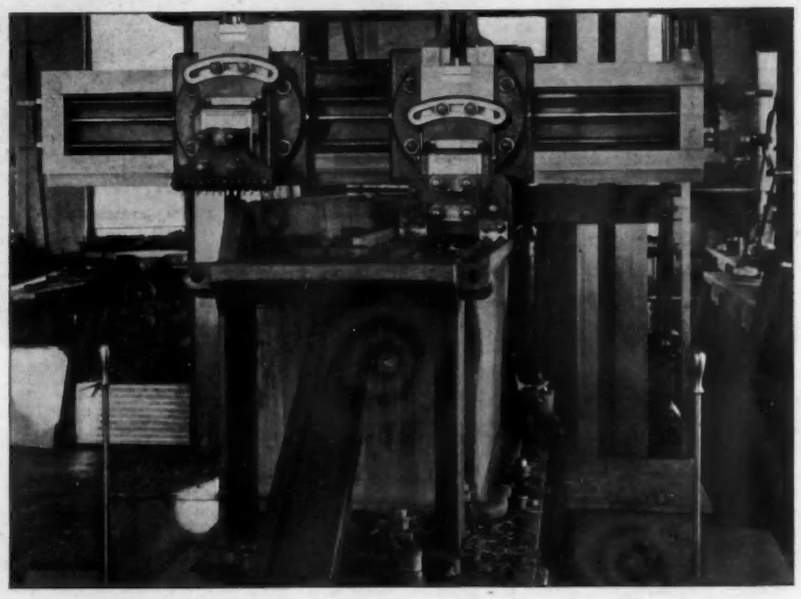


FIG. 14. PLANING GRINDER BEDS, GANG AND FORMED TOOLS.

## The Shops of the Landis Tool Company—I.

Experience in building and in the use of the special grinding machines described in last week's issue led the brothers Landis to believe that a business could be built up in the manufacture of such machines for the market. They started a shop in Waynesboro (Pa.) under the name of Landis Brothers, which shop in April, 1897, about the time they had become well established and when success seemed assured, was destroyed by fire. In the work of rebuilding it seemed advisable to accept the financial aid of others, and the Landis Tool Company was formed, the manner in which the business had been conducted having inspired that degree of confidence which made it easy to secure all the capital necessary for the erection of first-class shops and for their equipment. These shops are of brick, two stories high, with a gallery on one side, as shown in Fig. 13, which is taken from a point in the erecting floor, which floor is lighted from all sides and from the roof as well, and is commanded by a hand traveling crane equipped with an air hoist. At the right in this view the planing is done, while in the back-ground are done the heavier lathe work, milling, etc. On the gallery above, the smaller lathe work and other manufacturing operations are carried on, and here is located the tool room with a very ingenious and efficient elevator arrangement for carrying tools and supplies from one floor to the other. It will be noticed that the two posts nearest the planer in Fig. 13 are utilized for swinging cranes with air hoists, and in the back-ground is seen the overhead rail, on which other air hoists are placed and which convey work from one part of the floor to another under the gallery where the larger crane is not available. The shop is heated and ventilated by the hot air blast system, the pipes for this being a prominent feature of this view.

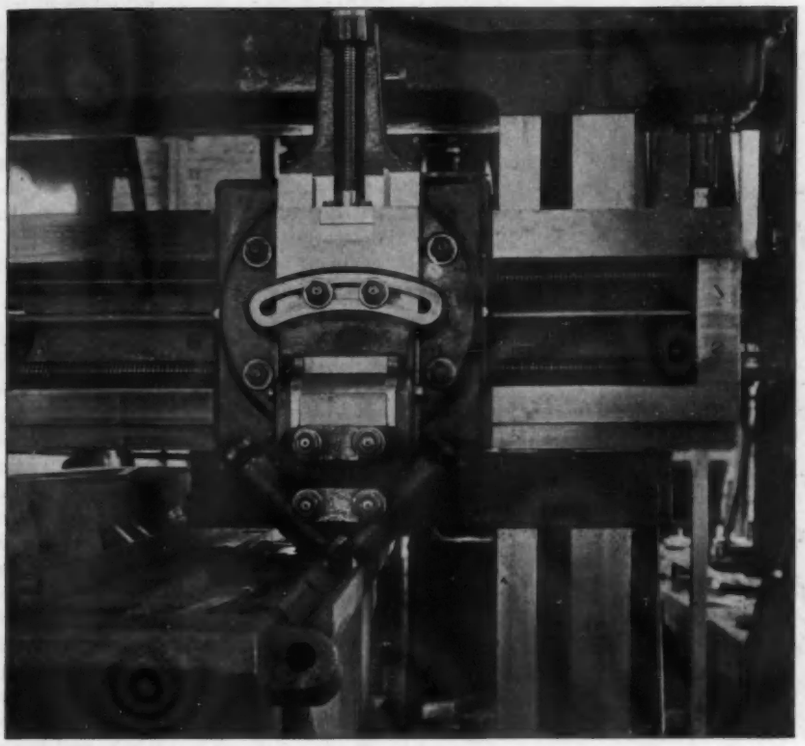


FIG. 15. FINISHING TOOL FOR V-WAYS.

On this floor some very advanced practice is to be seen in planing and in other operations, some of which I am able to describe and illustrate. At Fig. 14, for instance, the bed of a grinder is shown upon a planer table. The planer rail has two heads on it, and the one at the left carries a gang tool for taking the roughing cuts off from flat surfaces where the depth of cut is not great. Into a suitably shaped casting which goes over the studs as shown, twelve tools, made of a very high grade steel, are inserted and secured by set screws. These tools are in this case 1 inch apart, and when the tool is to be used it is set level, fed down into the work to the proper depth and then fed along the rail for 1 inch, when a surface 12 inches wide is rough planed and is afterward finished in the usual manner with a single broad tool and wide finishing cut.

The right-hand head in Fig. 14 is engaged in roughing out the ways on which the platen of the grinder moves. In this case a suitably formed casting carries two planing tools, one of which is flat and the other V-shaped to conform to the shape of the ways. These tools are independently adjustable, vertically, as shown, and previous to being used, are ground and set to a gage which insures them being the proper form and in their relative proper positions. An extra support for this tool is seen at the right and extending out to

FIG. 16. PLANING THE SLIDES OF A GRINDER PLATEN.

bear upon the face of the upright. On account of the hight of the cut from the planer platen in this case it is found not to be practicable to finish the surface of the ways in this manner, and so for this the tool shown in Fig. 15 is used. This has two cutting tools arranged to feed in lines precisely 90 degrees angle to each other, and the tools are fed down by hand by means of the small wheels shown. Thus the necessity for setting the head first to one side and then to the other is entirely avoided, and much time is saved, besides insuring that the angles will be right every time. The flat way is finished in the ordinary manner with a broad tool and feed.

FIG. 17. ERECTING FLOOR. LANDIS TOOL COMPANY'S SHOPS.

The ways of the platen can, however, be finished by tools similar to that shown in Fig. 14, and in Fig. 16 a roughing tool is seen at this work; the finishing tool being held in reserve in the other head for operation after the roughing. These tools are of course the complements of the one shown in Fig. 14, and it is evident that by this method not only is much time saved, as compared with ordinary planing methods, but exact shapes and exact relative positions of the two slides as to hight are much more certainly secured. It is evident that in this work a man is not likely to be asked to operate more than one planer, and he don't need to, for the one machine will do as much good work as any reasonable number of machines could be made to do by the ordinary methods of single cutting edges and two settings (one for roughing and the other for finishing) for each surface. In fact, this one planer does all the planing of this character that is done in this shop, an amount of work which, to make a guess, I should say would require about four planers working in the regular old-fashioned way.

At Fig. 17 is another view of the erecting floor, and showing at the back the end wall of the shop, which is not of brick, but is designed to be moved out when it becomes desirable to enlarge. In this view grinders are seen in various stages of completion, and it will be noticed that there are three straight edges in the field, all arranged to be handled by the air hoists in applying them to the work. This liberal provision for and actual use of straight edges in finishing the various sliding surfaces is in fact one of the prominent features of the shop; the place seems pervaded by them, and means are provided for handling them on to and from the work with the minimum of time and effort expenditure. At Fig. 18 is a group of the straight edges and surface plates laid out on the floor and photographed for the purposes of this article. The largest of these is 16 feet long and 2½ inches wide on the face, and the method of handling it when in use is shown in Fig. 19, where it is suspended by the air hoist and the V of a grinder bed is being scraped straight by means of it. In connection with this work of planing and otherwise producing straight surfaces I noticed the device shown in Figs. 20 and 21, which seemed to me to be especially interesting and ingenious, while it also serves to show the degree of pains taken here to have things just right.

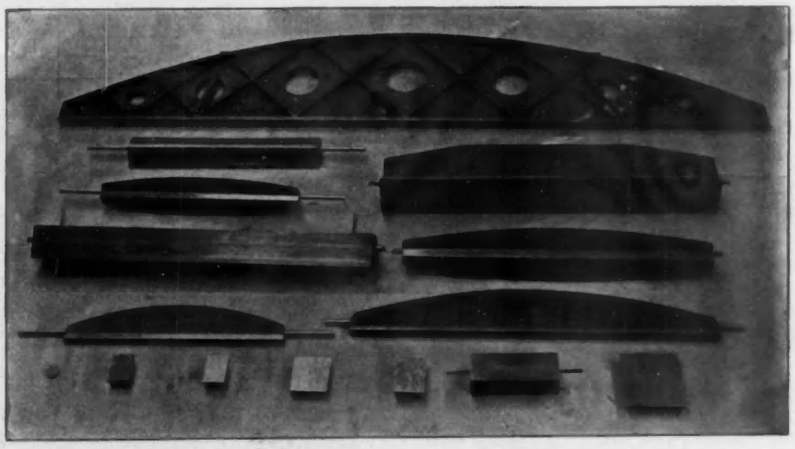


FIG. 18. GROUP OF STRAIGHT-EDGES AND SURFACE PLATES.

Fig. 20 is a cross section of a part of the Landis grinder. When the machine is completed a shaft carrying a pinion at its inner end passes through the bushings, in which the cutter bar is now seen. This shaft and pinion give motion to the platen upon its ways, the pinion engaging with a rack which is attached to the lower side of the platen and rests upon the surfaces *H H*, which fix its hight. Since various amounts of scraping are required to bring the surfaces of the bed and of the platen to agree with the standard straight edges and to fit each other as scraped sliding surfaces should, the seat for the rack cannot be planed to a finish when the other planing is done, but some allowance must be made for the variation which is sure to occur. So after the scraping is done, the shaft with its pinion is passed through the bearings until the pinion is in its place, but the platen is removed so that the pinion is entirely accessible. The rack is then placed on top of the pinion in engagement with it, as it is to be in the finished machine, and the gage, Fig. 21, with its base resting upon the scraped surface of the flat way is carefully set to the top of the rack, and therefore represents the exact hight the surfaces upon which the rack is to rest ought to be with respect to the ways. Then the shaft and its pinion are removed and the cutter bar, Fig. 20, is put in its place as shown, and the cutter

adjusted to gage as indicated in Fig. 21. Then the platen is put on and the surfaces *H H* on which the rack is to rest are planed by the tool so set, this planing being accomplished simply by moving the platen upon the bed by hand and feeding the tool by means of the screw *B*. Thus the rack is sure to be not only the right hight to mesh correctly, but is also precisely in line with the scraped surfaces. Of course the cut removed by this operation is a very light one.

*(To be concluded next week.)*

## Machine Tools—V.

BY J. RICHARDS.

DESIGN AND ARRANGEMENT.

With what has preceded in a historical way some of the features or principles of machine-tool design will next be considered, beginning with supporting frames.

Such machines have two principal functions: To hold and present the material operated upon, and to support, guide and actuate the cutting tools. These two functions are represented by two "terminals," they may be called, of the machine, connected by the framing. Between these terminals are borne the strains, which may be direct, transverse, torsional or compound.

To illustrate this, suppose that in Fig. 29 *a* and *b* are frame terminals, *c* a tool of any kind, and *d* a piece to be operated upon. The strains developed, whatever their nature, have to be transmitted, or resisted, by framing extending around from *a* to *b*, as indicated by dotted lines. This represents one type of framing, commonly called enclosed or continuous.

As, however, the dimensions of most kinds of work do not permit frames of this kind they have to be single, or open at one side, as indicated by the dotted line in Fig. 30, where the same letters of reference apply. The strains in either case may be, as before remarked, direct, as in punching; torsional, as in boring; or transverse, as in milling.

In Fig. 29 the section of the framing is not a matter of great importance. The two sides of the frame compensate each other, but appearance, convenience and economy demand that such sections be hollow or cored, and symmetry requires in most cases that the faces be plain and the corners rounded.

In Fig. 30 the problem of framing is

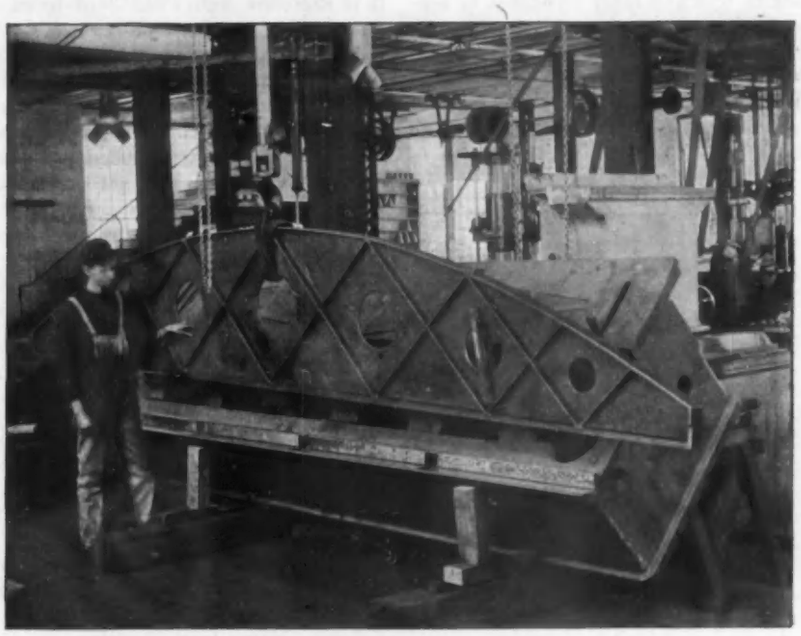


FIG. 19. LARGE STRAIGHT-EDGE IN USE.

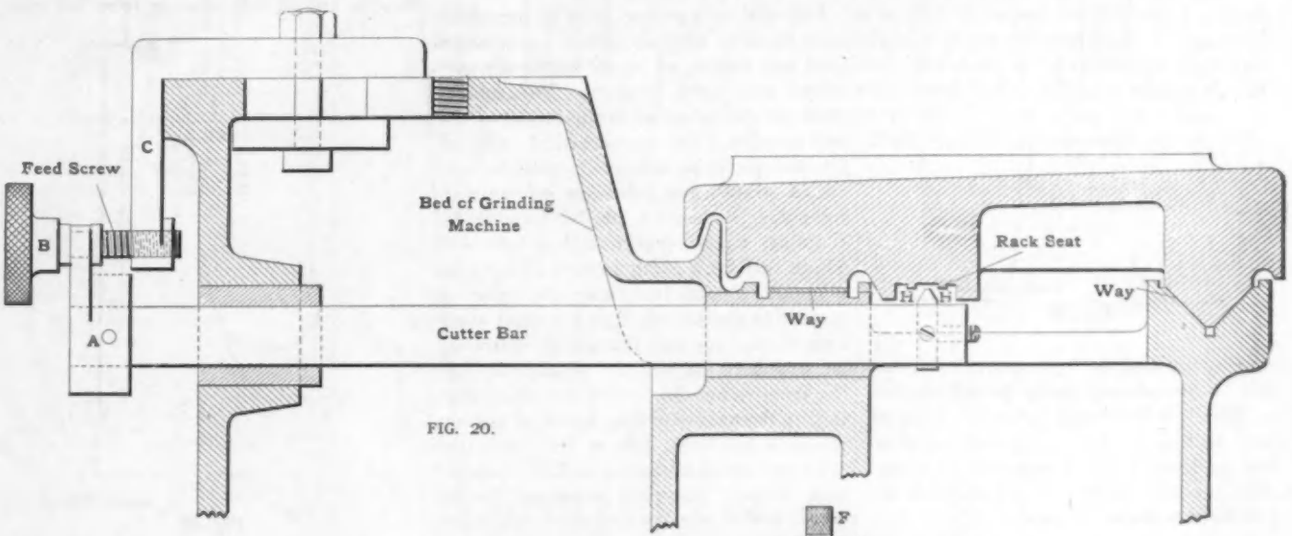



FIG. 20.

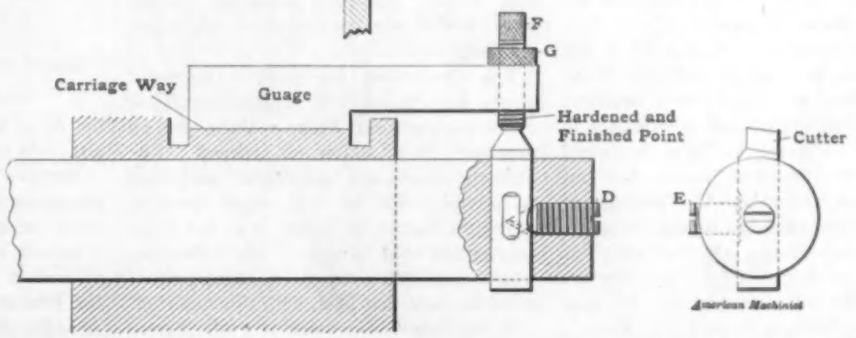



FIG. 21. FIXTURE FOR FINISH-PLANING THE SEAT FOR RACK AFTER SCRAPING HAS BEEN DONE. LANDIS GRINDER.

much more intricate than in Fig. 29. The strains on the vertical member are intensified and changed, direct stress is changed to flexure, torsion is resisted by a short radius and transverse strains are doubled. The nearest adaptation of section and contour in such a case will be to consider the vertical member as a projecting beam, as shown in the diagram, Fig. 31.

This, we find, has, by natural selection or accident, become the ruling form for machine tool and other standards to support cutting implements. Such form cannot, however, be based entirely upon resistance to strains. There are other conditions to be considered. There must be a base, as shown at the left in Fig. 31, to provide stability and for fastening to

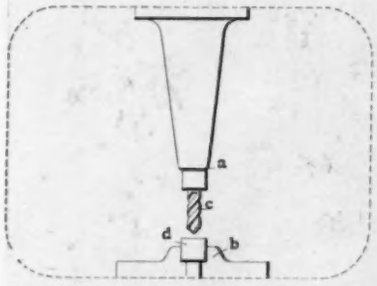



Fig. 29

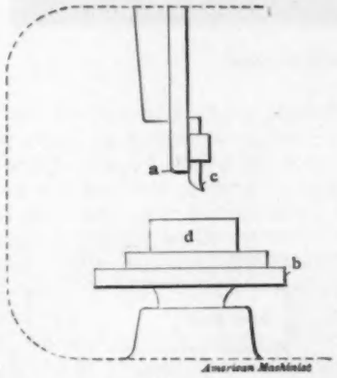



Fig. 30

foundations, and the top requires modification to provide for parts bolted or cast on there; so the frame takes the form as seen in Fig. 32, or an approximation to that, and the whole appearance of a machine becomes affected in a wonderful degree by this shape or contour.

Mr. Beyer, of Beyer, Peacock & Co., the locomotive builders at Manchester, England, when their new works were equipped about 1875 attached enough importance to this matter to have carefully developed curves for the machine frames laid out and furnished to machine-tool makers, so the works when complete would present a harmonious appearance, and the result was as he expected it would be. This feature was noted by all visitors, and the particular form became known as "Beyer's curve."

It will be a matter of astonishment to those who have not previously considered the matter to discover the extent to which this form of the projecting beam or bracket enters into machine-tool framing. In that type called vertical machines, such as those for drilling, slotting, and planing, nearly all have this feature, and it has besides a wide place in horizontal supports that project from the main standards, such as tables for drilling, or other purposes. It is therefore well worth considering as a distinctive feature in design.

This form of standards comes nearer to being constant than any other feature of modern machine-tool making that can be named, and is commendable in every way; but it is often spoiled by inharmonious bolted-on parts, such as have a ribbed section when the main member is hollow or cored. This is an incongruous thing, too common in practice. There is nothing saved and generally something lost by attaching ribbed parts to box framing. Good practice demands that all bearings requiring positive alignment be cast integral with the main frame and in harmony therewith, as shown in Fig. 33, but the lack of proper handling, boring and facing facilities prevents this in many of the machine-tool works.

Fig. 33, which is a composite design for a plain drilling machine, illustrates a symmetrical form for junctions between a main standard and its auxiliary members. It is a composite drawing from several different designs by good makers.

RIB AND CORED SECTIONS.

This will be a proper point to introduce some remarks upon the difference between solid and hollow, or, as we commonly say, ribbed and cored sections. The subject needs no discussion as to the merits of the two systems. The mathematical value of the sections varies continually with the nature of strains, and a tedious reference to computed data may all be avoided by claiming, as all experienced people will admit, that for a given amount of material a hollow section has twice the value in respect to the strains that are most common in machine-tool frames, or, conversely, that half the amount of material has the same value. In torsion it is more than this, in flexure something less, and in compression less still; but as torsion is the principal strain to be resisted in machine-tool frames, especially machines having rotary action, the "two to one" rule is not far from fact.

The dimensions for machine frames—or the section, as it is common to say—defies computation, because there are no premises from which to proceed. The ultimate strains are "accidental" and must be provided for by that vague quantity called "a factor of safety," an arbitrary assumption that savors of the ridiculous when considered from a mathematical point of view; but even with this qualification, the frames for machine tools present another impediment to fixed rules. Computations should include a point of rupture, which in all static structures and in most kinds of machine framing is a proper element or condition from which computations can proceed, but in machine tools there is another limitation, one difficult to explain, which Mr. Oberlin Smith once happily termed the "anvil principle," or the effect of massiveness. This peculiar property in machine-tool parts, supposed to arise from inflexibility, is one of those

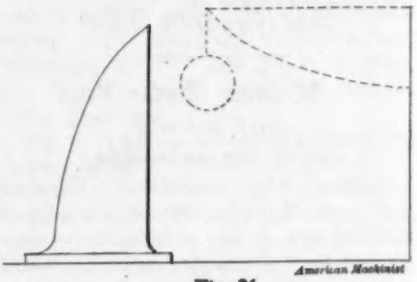



Fig. 31

FORM OF STANDARDS.

things perhaps not explainable on scientific grounds, but well known to practical men as a "fact."

There are various phenomena attending on the action of cutting tools, empirically learned and never investigated. A workman knows when to put a piece of leather under a tool to produce an elastic support, as in scraping. He also knows when such a thing would be ridiculous in ordinary working. He also knows that he can successfully turn off a grindstone with a flexible rod of soft steel or iron, but can-

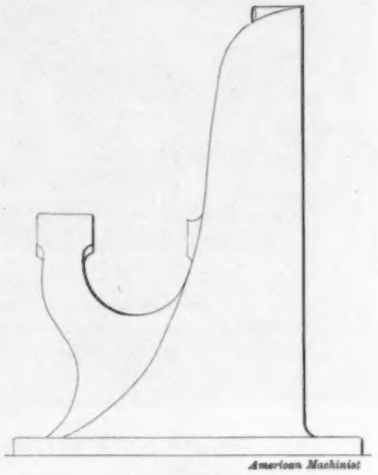



Fig. 32

STANDARD MODIFIED BY ATTACHMENTS.

not do so with a stiff bar that is hardened, although he cannot explain the reason.

Massive sections about a slide rest and elsewhere around a lathe produce an effect upon the action of the tools as marked as it is well known. The same thing is true of almost any kind of machine tools, so the limitation of rupture or the ultimate strength of material does not enter into the problem, and the true limitation of

sections is found in first cost and the convenience of handling.

In this fact is found one principal reason for the non-scientific methods of machine-tool makers alluded to in the first section of these articles.

As before remarked, rigidity is a primary object in machine-tool frames, limited only by commercial considerations and convenience; but it is often impaired by faulty arrangement and design. Lathe beds as commonly made are an example of badly distributed material.

A drastic criticism once heard on open lathe beds was: "They are made like a ladder so as to twist easily and then set on four points so they will spring and follow the settling of the floors and foundations." This is an extreme illustration, but with a large admixture of truth in it.

The principal strains to to which lathe beds are subjected are torsional. The "torque" on the work and on the lathe frame being compensating, must, of course, be equal.

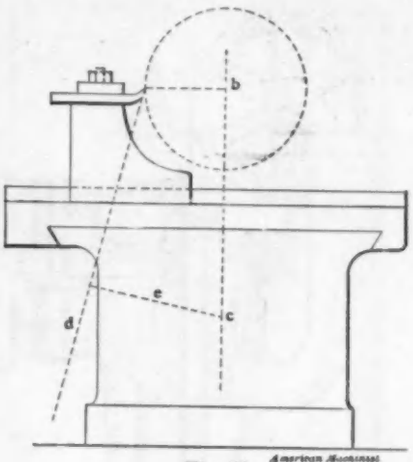



Fig. 34

STRESSES IN LATHE BED.

Referring to the diagram, Fig. 34, the cutting strain becomes a turning moment about the axis *b* and is transmitted to the lathe bed, as on the line *d*, exerting a twisting strain upon the frame about a center *c* on the radius *e*. This is the same in all the various operations performed on lathes, because the driving force is converted to torsion or turning strain, consequently, the section of a lathe bed, with due consideration to some other requirements, should be such as will best resist torsional strain. Such section we need not say is a tube or box one and not two side plates connected at intervals by cross framing. In fact the latter is one of the weakest forms in which the metal can be disposed.

If, for example, we bend a strip of metal into the form of a trough, as in Fig. 35, it will have but little stability in respect to torsion. If the fourth side is added, as in Fig. 36, but with a slit at *a*, the result is not much changed and the stability will equal that of the sum of the four sides twisted in their flat section; but if the slot *a* is joined so as to form a complete tube everything is changed. A twisting force will then fall "edgewise" on the plates forming the sides, and the stability of the same section in respect to torsion is increased enormously.

This may be called an unscientific method of presenting the subject, but it only illustrates in an extreme degree the

Fig. 36

Fig. 35

difference between tubular and plate sections for lathe beds, or frames of the kind. The relative stability compared with the amount of material, of course, increases as the plates are reduced in thickness, also in respect to different kinds of strains and for different kinds of material, but the conditions applying to machine-tool frames of this kind are tolerably constant, both as to material and strains.

Figs. 37 and 38 represent an example

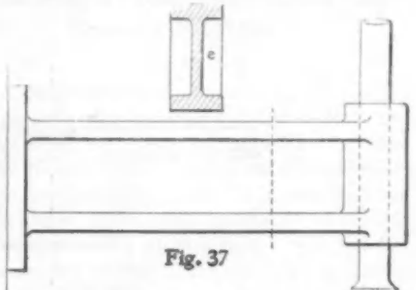



Fig. 37

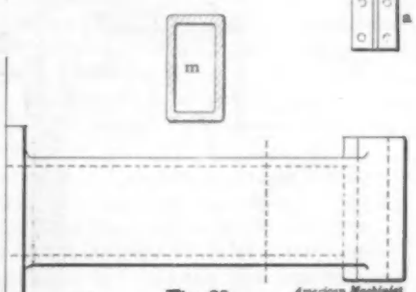



Fig. 38

CASE SHOWING THE ADVANTAGE OF BOX SECTION.

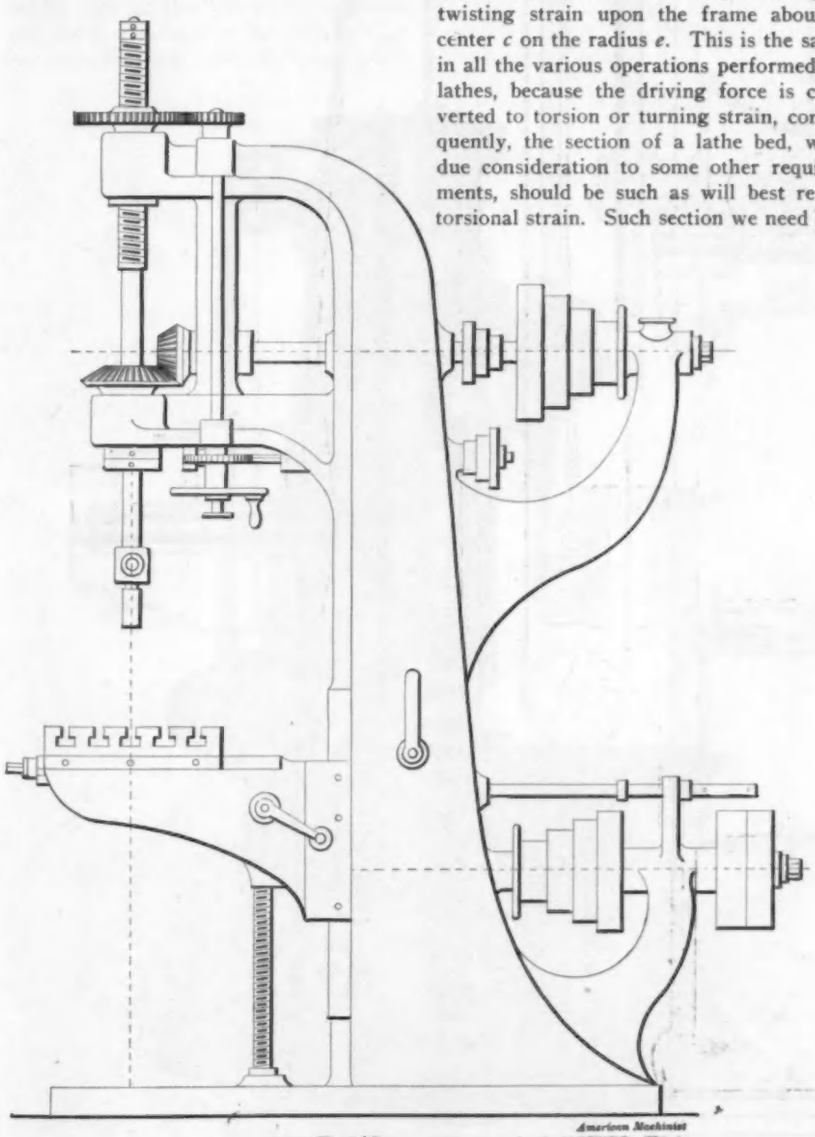



Fig. 33

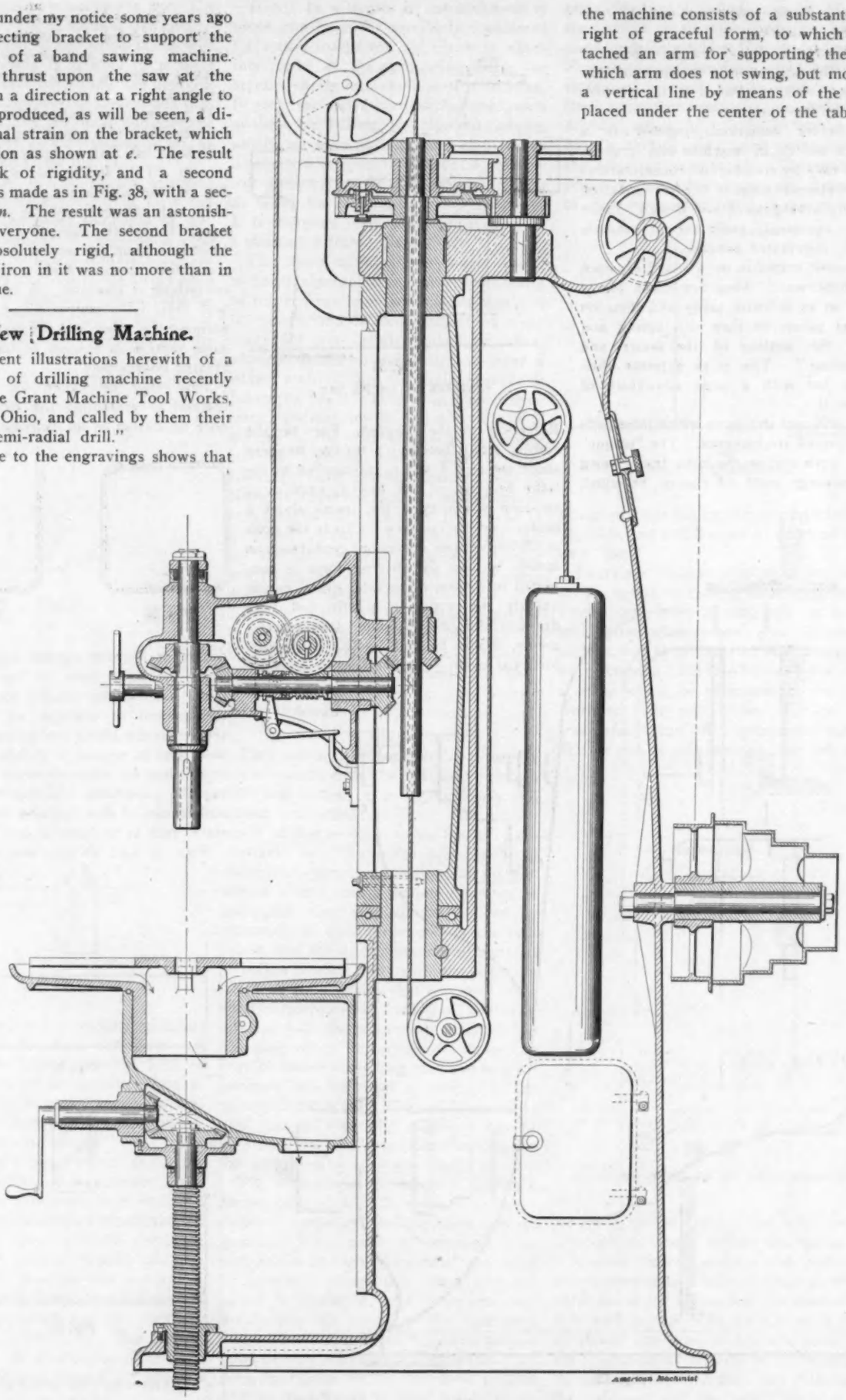
EXAMPLE OF DESIGN OF A DRILLING MACHINE.

that came under my notice some years ago of a projecting bracket to support the guide-stem of a band sawing machine. The back thrust upon the saw at the guides *a*, in a direction at a right angle to the paper, produced, as will be seen, a direct torsional strain on the bracket, which had a section as shown at *e*. The result was a lack of rigidity, and a second bracket was made as in Fig. 38, with a section as at *m*. The result was an astonishment to everyone. The second bracket seemed absolutely rigid, although the amount of iron in it was no more than in the first one.

## A New Drilling Machine.

We present illustrations herewith of a new style of drilling machine recently built by the Grant Machine Tool Works, Cleveland, Ohio, and called by them their "26-inch semi-radial drill."

Reference to the engravings shows that the machine consists of a substantial upright of graceful form, to which is attached an arm for supporting the table, which arm does not swing, but moves in a vertical line by means of the screw placed under the center of the table, the



VERTICAL SECTION OF 26-INCH SEMI-RADIAL DRILLER.

weight resting upon a ball thrust bearing, and the gearing and crank being arranged as shown in the sectional view, Fig. 2. Reference to this figure shows that the table itself rests upon a ball bearing to facilitate rotation of the same by hand, and channels indicated by the arrows on this view show the course of lubricant used in drilling as it flows from the work; this arrangement being adapted to keep the machine neat and clean.

The arm supporting the drill spindle and feed mechanism is attached to a pivoted trunnion piece, or vertical rail, the weight of which is also borne on ball bearings, as indicated, and the method of driving is clearly shown in the vertical section. The back gearing is placed on the spindle itself, and the vertical splined shaft has a hole bored through it to permit the counter-balance table to pass through it on the center line of the drill arm swing, thus avoiding interference with the arm in any position. The back gears are thrown out or in by the crank handle seen at the left of the machine, and there are, besides the power feed, two rates of hand feed, the rapid movement being by means of the hand wheel in front of the arm, the slower movement by the hand wheel at the right. It will be noted that this arm, which is relatively a small part of the machine, contains most of the mechanism, and can be constructed and assembled separately. The machine was designed by John J. Grant and has been in use for some time in the works of the above-named company.

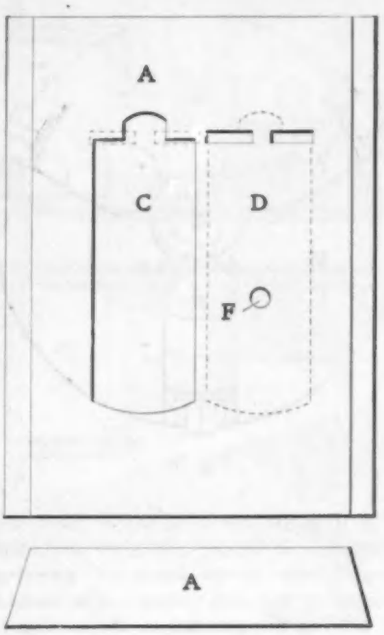



Fig. 1

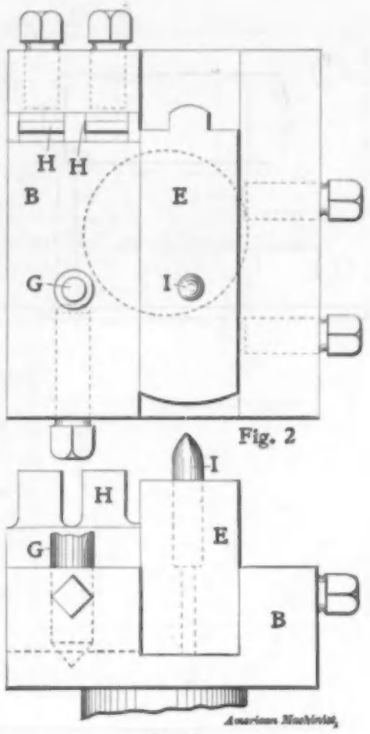
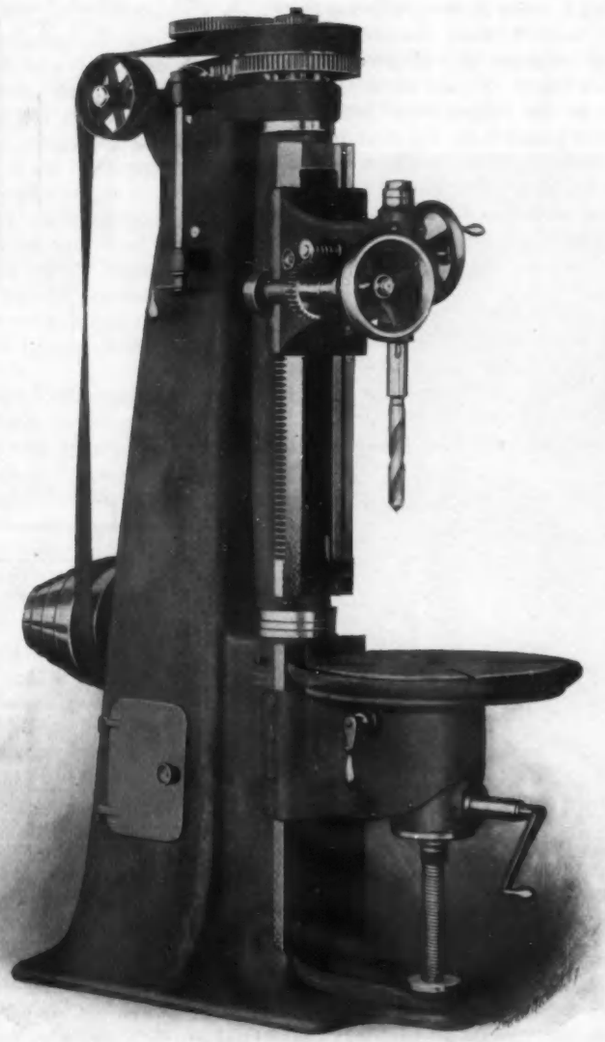



Fig. 2




Fig. 3

PUNCH AND DIE.



26-INCH SEMI-RADIAL DRILLER.

## Making a Punch and Die in a High-Pressure Machine Shop.

BY A. H. CLEAVES.

Once on a time, owing to a deficit in the revenue department, I found myself out of a job for a few hours, and I proceeded at once to inquire about an advertisement in the morning paper. I approached the foreman of the shop mentioned in the advertisement, and told him I was out for anything in the hardware line; and after asking me what pay I wanted, and finding it to be $3 per day, he said he would give me $2.75 for two weeks and then make it $3 if I filled the bill.

So I squared away and went at it, working out several jobs on my own lines, which he accepted, for the two weeks, when he dropped me suddenly, telling me that the following die, which I describe, could be hired done outside for $12. I found there were others with the same experience, and that the firm was enjoined for using someone else's invention, and finally crawled into a smaller and darker crab-hole, as such dealers usually do. The shop had a fine shaper, first-class, the other tools being nearer fourteenth; one

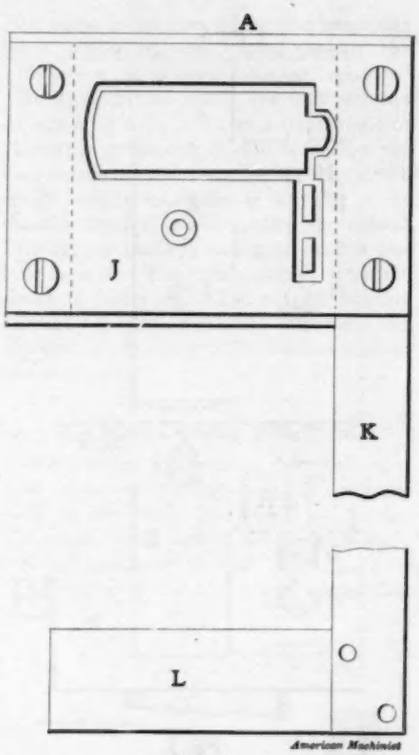



Fig. 4
STRIPPER.

set of files for four men, a few sizes of drill rod and die steel, and a diminutive number of twist drills and taps.

The punch and die referred to and shown in Figs. 1, 2, 3 and 4 was made of annealed steel, and was about 4x5 inches in the die stock. In Figs. 1, 2 and 3 the method of making a pretty safe die, considering the thickness of stock, is shown. *C* and *E* show one die and punch, and the dotted lines *D* show the complete shape of the punching. The double punch *H H* makes the neck in the blank safely, and the main punch and die *C* and *E* enter the spaces made by *H H* in such a way as to avoid corner punching, and make easy work for this punch. *F* and *G* make a required hole, which also allows the use of the usual pilot pin *I*.

It will be seen in Fig. 3 that the pilot pin *I* is made full size enough longer than *H H* to locate the stock before the latter commence to work; and *H H* are made longer than *E* to admit of grinding oftener, as they dull quicker. The method of holding the punches in the casting *B* is plain, and the dies were made by hand, no conveniences being near for short cuts.

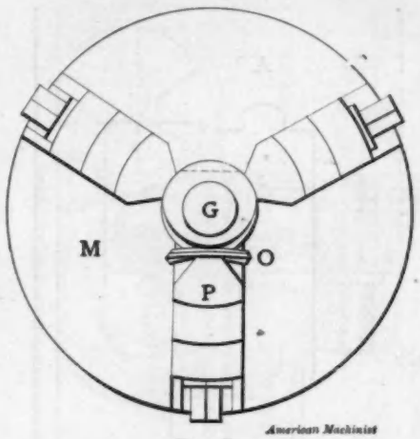



Fig. 5

Fig. 4 shows the stripper and style of guide strip used, the piece *K* running under *J*, and *L* under *K*, level with the die.

Figs. 7 and 8 show two different methods in common use of getting the angles on *A*, Fig. 1. *S S* are about ¼-inch drill rods in the shaper vise, and *T T* regular bevel parallels for the same result.

Fig. 5 illustrates how the punch *G* was put up in the rough-rider way. The hole for *G* being drilled in *B*, and the former being brought to place with a set screw, a circle on *G* was marked through *F*, Fig. 1, *H H* being left longer than when finished to locate G by.

Having only a fixed three-jawed chuck to turn *G* by, a paper placed between one jaw *P* and the work *G* furnished the required eccentric, and what was still lacking in lining up *G* and *F* in the work was made up by soaking a cold chisel *Q* into the casting near *G*, to throw the latter over, as shown in Fig. 6. The different set screws were tightened up and then driven deeper with a hammer and tightened again.

The three remaining figures are samples

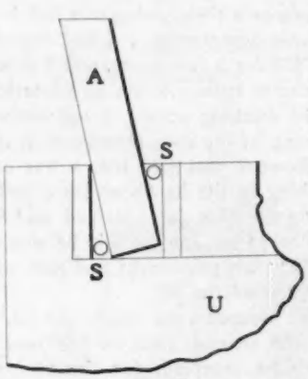



Fig. 7

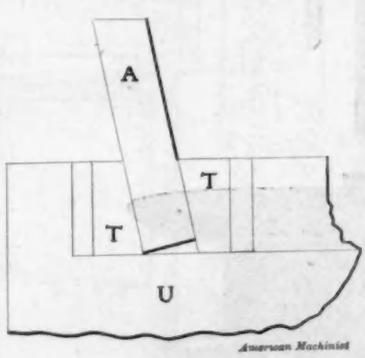



Fig. 8

PLANING ANGLES.

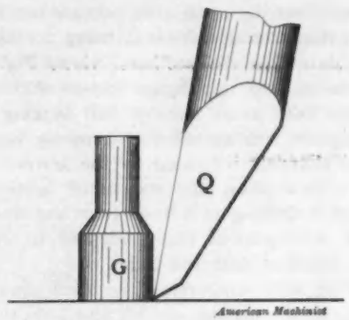



Fig. 6

of chucking die work for lathe and drill press, miller, etc. Fig. 9 is a block suitable for face-plate work, and Fig. 10 illustrates a common practice of clamping a piece on parallel bar for boring clear through.

Fig. 11 is a general utility stand for handling work in the punch-holder in any kind of a machine, drilling, milling, turning, or shaping.

Peoria Heights, Ill.

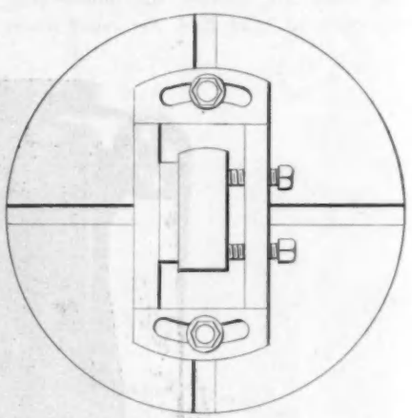


Fig. 9

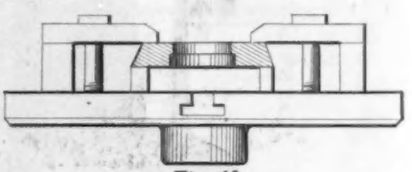


Fig. 10

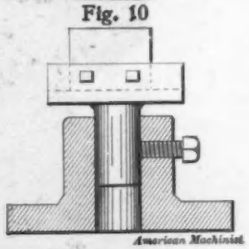



Fig. 11

CHUCKING WORK.

## No Monopoly of Intelligence.

The Boston "Christian Register" is credited with the wise remark that anybody who knows enough can learn something from anybody else.

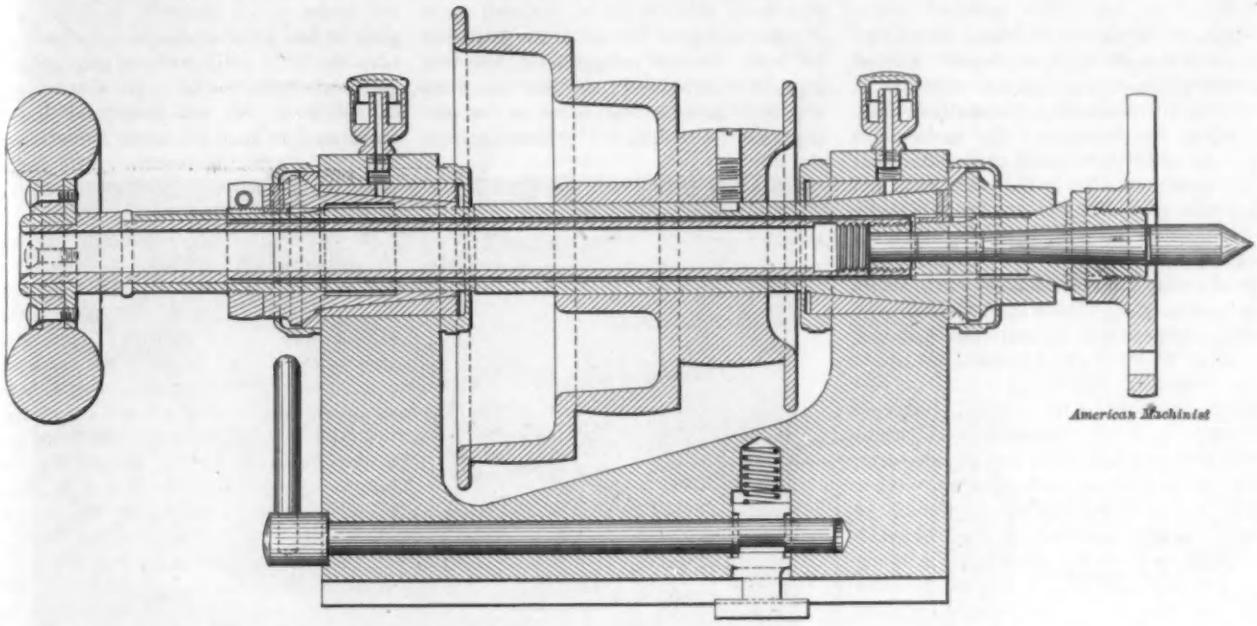



**Fig. 1**
PRECISION LATHE HEAD-STOCK.

## Precision Grinding.

Among the products of the Pratt & Whitney Company is a line of small precision machine tools, among which are a small bench lathe, of the type made by various watch-tool companies, and a small milling machine of the knee type. These machines are representatives of the very highest degree of accuracy obtained in commercial work of any kind, and the processes employed in their production are interesting in the highest degree. This article will relate to the methods used in the construction of the bearings and spindle of the lathe head-stock.

Fig. 1 is a longitudinal section of this member, from which the character of the work to be done will be apparent. The bearings will be seen to be made of inserted bushes which are of hardened steel, are whole, and have two tapers which are laid out to approximate the Schiele curve. The corresponding journal at the work end of the spindle is integral with the spindle; but at the rear end is a separate bush which is adjustable endwise for wear. Draw-in or collet chucks are used to carry the work when this is made from a rod, and also to carry the face plate and center as shown in the engraving.

The making of the spindle—with the exception of the taper collet seat—presents no unusual features, the journals being ground on a universal grinding machine. The holes in the head-stock body for the reception of the bearing bushes are lapped with a long lap passing through both at the same time, whereby truth in alignment, roundness, and correct size are secured. The bushes are hardened and are then relieved from hardening strains by warming to a temperature at which water will "skate" off the surface, or in other words, assume the spheroidal state. At this temperature there is no drawing of the temper—the bushes remaining glass hard—but long experience of the Pratt & Whitney Company has shown that this warming of the pieces does release the hardening strains. Bushes so treated may be subjected to the finishing processes with the certainty that they will not thereafter change their size, whereas without this warming, the permanence of the size is a matter of the greatest uncertainty. Some of those engaged in this work consider that the warming only releases the hardening strains up to the temperature employed, so to speak. In other words, they consider it probable that, were the piece to be again heated above the skating temperature, further change in size would probably result; but as the temperature

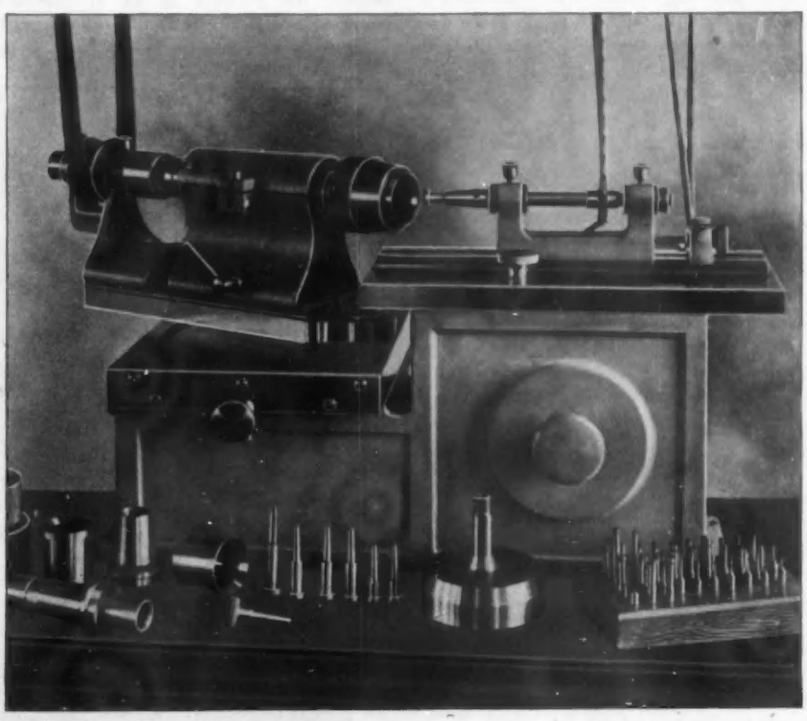


FIG. 2. AUTOMATIC BENCH GRINDING MACHINE ARRANGED FOR GRINDING LATHE BEARING BUSHINGS.

employed is beyond anything which the parts will ever again experience without absolute abuse, the practical effect is to remove all tendency to change their size.

After this treatment the bushes are ground upon the outside to standard size and to fit their seats in the head-stock, and are then ground on their inner surfaces by the small special bench grinding machines shown in the half-tone illustrations. Fig. 2 shows one of these machines clearly with a bush in place in the machine and with several other bushings and other pieces of work on the bench. At the right will be seen, set in a wooden base, an assortment of diamond "laps" with which the work is done.

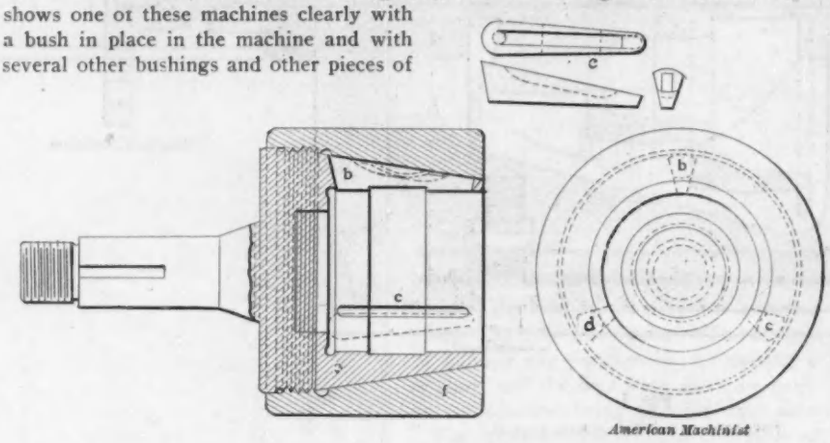



**Fig. 3**

CHUCK FOR HOLDING BUSHINGS.

The bush to be ground is in a chuck on the end of a spindle mounted in a head which again is mounted on a swivel base by which the adjustment of the angle is obtained. The chuck employed is a special design for this purpose, and is shown in Fig. 3. The body *a* fits the spindle of the work-carrying head by the regular taper fit used with collets; but it is, of course, solid. The chuck is bored out—or rather ground out—to receive the standard bushes to be ground by a snug sliding fit. Three openings are cut through the body, as shown at *b c d*, into which three jaws *e* are dropped. Openings and jaws are wedge shaped, so that the latter cannot drop through, and the latter are of a thickness such that the outside taper sleeve *f*, when screwed home, will pinch the jaws sufficiently to drive the work—the pinching being, however, very slight, as the work to be done is of the lightest and most delicate character. The outer sleeve *f* is a loose fit on the threads at the rear end of the chuck to insure equal binding of all the jaws. Light springs are attached to the jaws to insure their withdrawal on loosening the grip, and so prevent the top one from dropping down in the way of the next bush to be inserted.

The chuck-carrying spindle revolves within a quill which is held in the quill rest, and which may be removed from the head by opening the latch top plainly seen in Fig. 2. The machines shown in Fig. 2 are always used in pairs, each one of a pair being set for one of the angles of the bush. On the completion of the first angle the latch is opened and the work with both quills is transferred to the second machine, where the second angle is ground.

The work driving belt is at the left of Fig. 2, and it will be seen that the belt pulley is mounted on a spindle of its own carried in bearings which are in a special casting. This pulley spindle drives the work-carrying spindle by a dog, not shown; the purpose of the arrangement being to avoid the deflection of the work due to the pull of the belt, which would result were the belt pulley mounted on the chuck spindle.

The grinding of the collet seat in the spindle is done with the spindle revolving in its own bearings. The swiveled baseplate of the grinding machine is fitted to take the lathe head-stock in place of the quill rest shown in Fig. 2; the center hight of the head-stock and fixture being the same, and the base fits being interchangeable. The grinding machine, with head-stock in place ready for grinding the spindle hole, is shown in Fig. 4.

It will be understood, of course, that the grinding machine has the usual characteristic movements of such machines. The cross adjustment for the cut is by the knurled head seen at the left. The lengthwise positioning of the wheel for the work is effected by adjusting the grinding head along the piece on which it is mounted, and the reciprocation of the wheel over the work is effected by the reciprocation of this piece on the box base of the machine—the belt at the extreme right driving the mechanism which effects this movement.

The greatest point of interest connected with this work lies, however, in the grinding wheels employed. It is found to be quite impossible to do interior grinding of the standard of accuracy set for this work by means of emery wheels. Such wheels will not correct the surfaces, but ride over the hills and sink into the valleys, leaving the work smoother, of course, but little better, as regards truth, than before. This action is considered to be due to the comparative dullness of the emery particles, in consequence of which considerable pressure against the work is necessary to make the wheels cut. With outside grinding, this has little effect. The wheel is carried in a firm support, and its mass and inertia help to prevent the wheel from following the surface in the manner described. In interior grinding, the situation is, how-

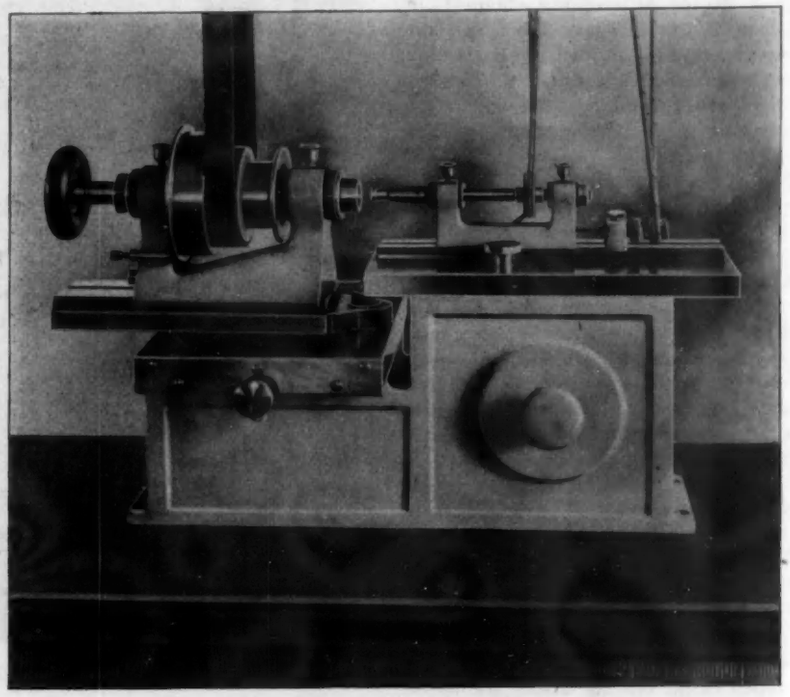


FIG. 4. GRINDING MACHINE ARRANGED FOR GRINDING SPINDLE HOLE.

ever, entirely different. The wheel for this work is necessarily small and of little mass, and it is necessarily carried on slender spindles of considerable overhang. These conditions are all favorable to yielding by the wheel and its supports when pressure is applied, and the pressure necessary to make an emery wheel take hold is so great as to make really good work impossible. Emery wheels are therefore used for roughing only, and with holes of less than ¼ inch diameter are not used at all.

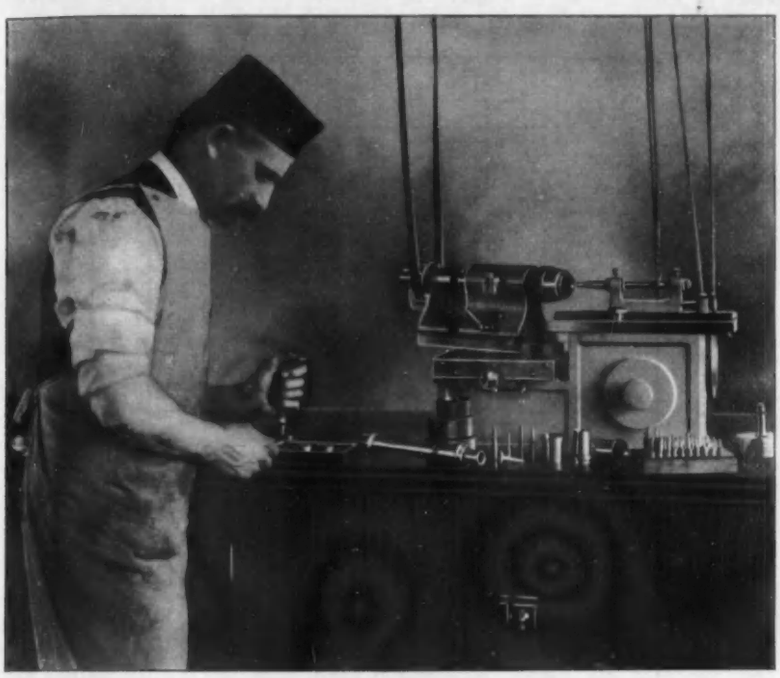


FIG. 5. CHARGING THE DIAMOND LAPS.

To meet these conditions, steel wheels or disks charged with diamond dust are used. These disks are called "diamond laps," although they are not used in a manner at all suggestive of what is commonly called lapping. They are used exactly as emery wheels are used, and a better, or at any rate a more descriptive, name for them would be "diamond wheels." These laps are all small, the largest being about ⅝ inch diameter by ⅛ inch thick, while the diameter of the smallest runs down to 2-100 inch. The speed at which they are run is of course very high. These laps have already been shown in Fig. 2, and the method of charging them is shown in Fig. 5. The material of the body of the disks is annealed tool steel.

A hardened steel plate having a well at one end will be seen on the bench, Fig. 5. The well contains the diamond dust mixed with oil. This mixture is spread upon the plate, and the workman, holding the spindle of the lap disk in the fingers of one hand and holding a T-shaped hardened-steel tool in the other, rolls the disk between the tool and the block in the manner plainly seen in the illustration. The pressure employed is not at all high—no more than can be comfortably exerted by the hand, but it is sufficient to imbed the diamond particles in the steel. Another method, though one that is not much used, employs a small jeweler's hammer, the disk being slowly rolled in the diamond dust and oil, while light taps are given it by the hammer.

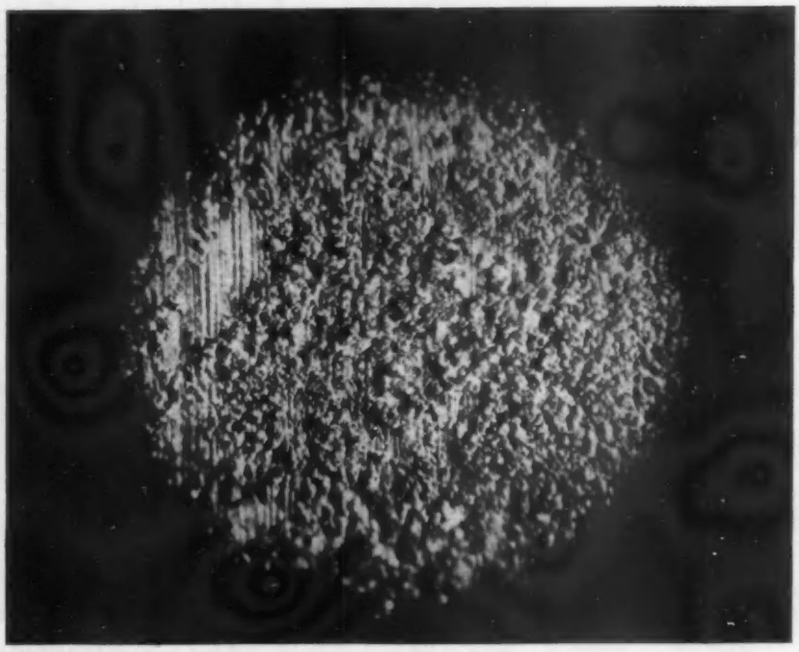


FIG. 6. PORTION OF SURFACE OF DIAMOND LAP MAGNIFIED.

Under the conditions of interior grinding described, the work done by these diamond laps is probably as much superior to that possible by an emery wheel as the work of the latter is superior to lathe work. Bearings which have run together long enough to show the character of the fit, exhibit a contact which can only be compared to that of finely scraped surfaces, while in appearance the surface is that of a highly polished or burnished piece of steel—the effect being mirror-like.

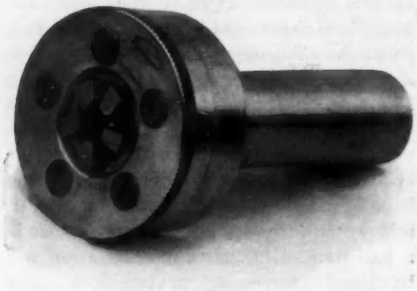
As these tools are but little known to mechanics in general, we have obtained samples from the Pratt & Whitney Company, and have had them photographed under a microscope. Half-tones from these micro-photographs are given in Fig. 6. True diamond dust is used in this work, not crushed black diamond or bort, and under the microscope these tools are beautiful objects, the particles being brilliantly transparent. It is, of course, impossible to reproduce this appearance in a half-tone print, but our illustration will be found interesting nevertheless. The roundness of the surface makes it impossible to sharply focus more than a small portion of it, and the print will be seen to be blurred at top and bottom. At various places where the diamond particles are scattered the tool marks on the disk may be seen.

## Adjustable Hollow Mill.

The engravings given herewith show a new form of adjustable hollow mill for use in the screw machine, and intended for those jobs which are done in comparatively small numbers where it perhaps is not worth while to make special tools for them.

A general view of the tool is given in Fig. 1, and it is shown taken apart in Fig. 2. It will be noted that the construction is very simple, the tool consisting of only three principal parts besides the

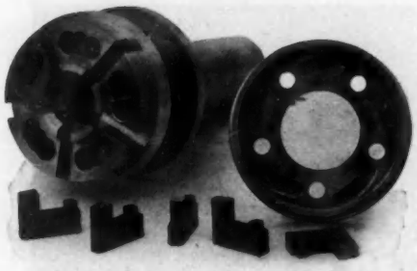
jaws. There is first a shank which fits in the turret, and in the enlarged end of this shank are radial slots to receive the cutters. A cap fits over the cutters; an interior view of this cap being shown in Fig. 2 where the cam slots appear that engage lugs formed on the front faces of the tools, so that by rotating this cap the



ADJUSTABLE HOLLOW MILL.

tools are adjusted to any desired size within the range of the tool, graduations being provided on the outside for setting to the nearest hundredth of an inch. Countersunk screws pass through the cap and flange and are tapped into a collar at the rear, so that when tightened they bind all parts of the tool securely together, making it rigid and preventing chips or dirt from entering the working parts.

The cutters are sharpened by grinding on the front faces only, and as they orig-



ADJUSTABLE HOLLOW MILL TAKEN APART.

inally project some little distance from the front of the tool, considerable grinding can be done before a new set of cutters is required. Two sets of these are supplied with each tool, and duplicates can be obtained.

Instead of using the index for setting to size a standard plug or sample of the work can be used for that purpose by simply rotating the cap until the tools are in contact with the standard. Three sizes of these tools are made to mill from ⅛ to ⅜ inch, from ⅜ to ¾ inch, and from ¾ to 1¼ inches, respectively, by the Geometric Drill Company, Westville, Conn.

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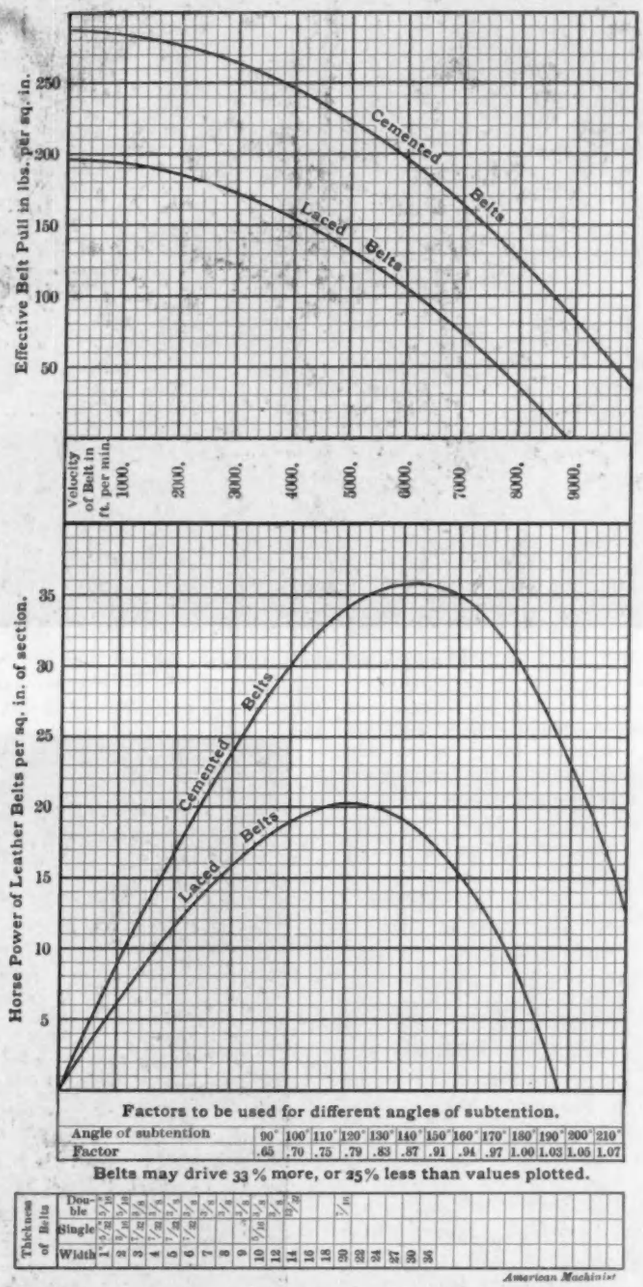
Wireless telegraphy is just now attracting considerable attention and may turn out to be a good thing. Perhaps we may hope some day to have wireless politics, which would be still better.

## A Diagram for Belts.

At the December, 1898, meeting of the American Society of Mechanical Engineers a paper on "The Variation of Belt Tensions With Power Transmitted" was presented by Professor W. S. Aldrich. In the discussion of that paper the accompanying diagram was presented by Mr. Wilfred Lewis. This diagram, in the words of Mr. Lewis, shows the practice of William Sellers & Co. It was adopted years ago as the result of the best light obtainable, a decided difference being then made between laced and cemented belts, but with the recent improvement in lacings the difference shown may now be too great.

The working strength of the leather is probably greater than Mr. Taylor would approve [As the result of his observations given in a paper entitled "Notes on Belting," published in Vol. XV of the Transactions.—Ed.]; but it is on the side toward which people naturally lean, saving in first cost, and it is offered in this connection as representing in concise form the outcome of the labors of William Sellers & Co. on the subject of belting.




**Factors to be used for different angles of subtention.**

| Angle of subtention | 90° | 100° | 110° | 120° | 130° | 140° | 150° | 160° | 170° | 180° | 190° | 200° | 210° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Factor | .65 | .70 | .75 | .79 | .83 | .87 | .91 | .94 | .97 | 1.00 | 1.03 | 1.05 | 1.07 |

**Belts may drive 33 % more, or 25% less than values plotted.**

| Thickness of Belts | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Double | 5/32 | 5/16 | 5/16 | 3/8 | 3/8 | 7/16 | 7/16 | 1/2 | 1/2 | 9/16 | 9/16 | 5/8 | 5/8 | 11/16 | 11/16 | 3/4 | 3/4 | 13/16 | 13/16 | 7/8 | 7/8 | 15/16 | 15/16 | 1 | 1 |
| Single | 1/16 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 |
| Width | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 27 | 30 | 36 | | | | | |

American Machinist

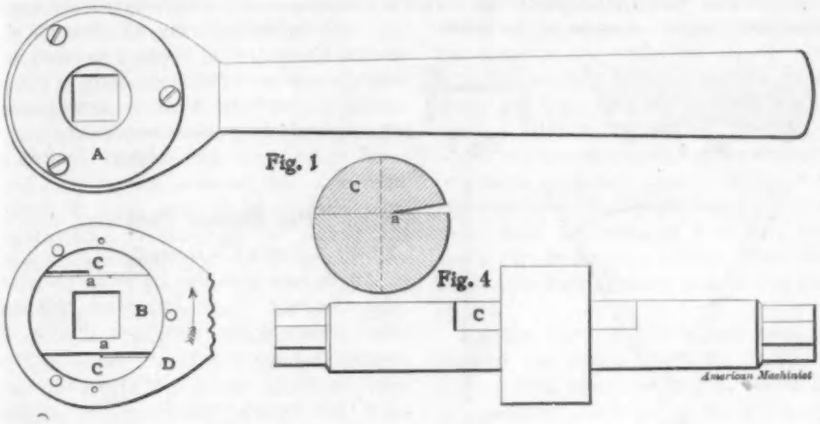
In these diagrams, the working strength of cemented belts has been taken at 400 lbs per sq. in. and that of laced belts at 275 lbs. per sq. in. The angle of subtention has been assumed to be 180°, and the coefficient of friction .40. The latter may vary from .25 for new or dry belts, to 1.00 or over for belts well dressed and in the best working condition. Total pull on shaft = 1.8 effective pull of belt.

The table at the left gives average thickness of belts of different widths, for use in calculating the cross sections.

POWER OF BELTING.

## A Simple Friction Ratchet.

The accompanying cuts show a simple but efficient friction ratchet device of wide adaptability. It may be used for all the purposes for which the familiar toothed ratchet wheel and pawl are usually employed, as in ratchet drills and wrenches, and for the feed or other intermittent movements of machines, and it may also be used for purposes for which the ratchet is not usually thought of. It is found to be especially serviceable for lathe mandrels for quickly gripping and securely holding work to be turned, and as quickly releasing it when done.




FRICTION RATCHET WRENCH AND LATHE MANDREL.

Fig. 1 shows a friction ratchet wrench embodying this device. The wrench is serviceable for turning taps, reamers, or similar tools. This wrench, like any ratchet tool, is, of course, reversed in its direction of rotation by simply turning it over. Fig. 2 shows the head of the wrench with the plate *A* removed and all the parts exposed. There is a central driving piece *B* with a square hole fitting the tap or other tool to be driven. The ends of this piece fit the circular interior surface of the head, while the sides of the piece are flat and parallel with each other. Against these flat surfaces the flat surfaces of the gripping pieces, or friction pawls, *C C*, normally bear, as shown in the cut, and when in this position the head *D* turns freely upon *B*. The head must, however, be turned only in the direction the reverse of that indicated by the arrow, for immediately that the head is turned in the direction of the arrow the friction pawls *C C* tip in the same direction upon their corners *a a*, the exterior cylindrical surfaces of them are crowded against the inner surfaces of the head *D*, and the central piece *B* is securely gripped. Turning *D* in the reverse direction immediately returns the friction pawls *C C* to their normal position, and the head at once is released and turns freely again. The bearing points *a a*, it will be noticed, are carried a little beyond the central line, the one to the right and the other to the left, and to this fact is due the distension of the pieces *C C* and the secure gripping which occurs. The gripping action in this case may be two-fold. The surfaces of *C C* and of *B* are nicely fitted to the interior surface of *D*, although they are still normally free to turn, so that only a very slight spreading apart of the friction pawls *C C* is necessary to make a strong grip; but when this occurs and the pressure is strong, say, at *o o*, then the interior of head *D* may become slightly elliptical and cause it also to pinch against the ends of the central piece *B*. The parts are, of course, all made of tool steel and hardened.

Fig. 3 shows a lathe mandrel as commonly used on the centers for turning collars which are secured by this gripping device. Fig. 4 is a section through the center of the mandrel, from which it will be seen that this is still simpler than the previous arrangement. In this case there is but the single gripping piece *C*, and the bearing point or fulcrum *a* of this piece also is carried a little beyond the center. This device is found to hold with absolutely reliable security and yet to release with ease upon reversing the strain. It, of course, never tightens in the least beyond what the strain on the tool calls for.

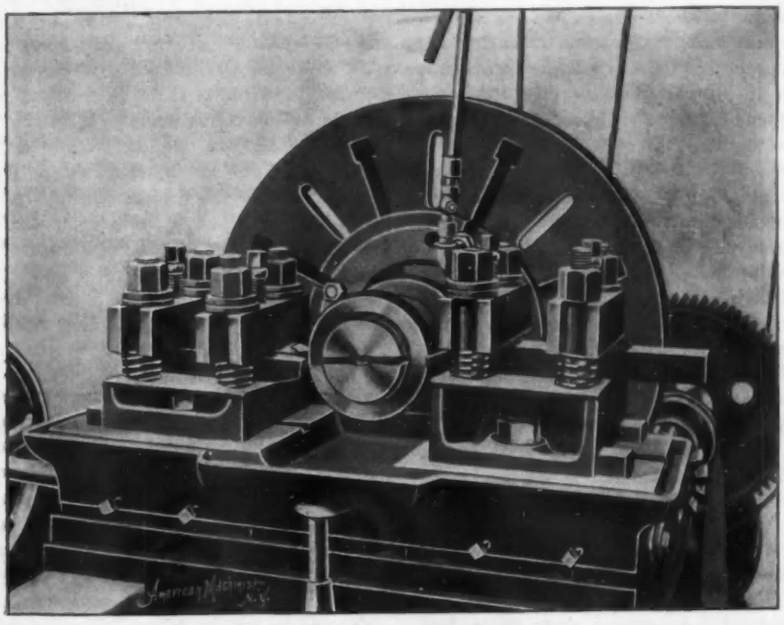


FIG. 5. SPECIAL LATHE FOR TURNING COLLARS AND USING THE FRICTION RATCHET MANDREL.

This device has been in use for a considerable time at the works of the George V. Cresson Company, Philadelphia, the well-known makers of power-transmission machinery. They built a special lathe, shown in the half-tone, Fig. 5, for turning steel collars for shafting, of which they of course use large numbers, and they have mandrels for the collars mounted on a chuck or face plate, this friction device being employed for the driving. A single tool which cuts both sides and the face of the collar is mounted in front of the collar for roughing, and a similar tool at the back for finishing. There is never the least slipping of the collars. On one occasion a workman jammed in the tools too abruptly and the cast-steel collar, with a section 1¼x⅝ inches, was split before it would slip.

The arrangement as shown in Fig. 1 for a ratchet wrench is of course eminently the thing for a ratchet drill. The grip is immediate and strong, and the loss motion of the venerable toothed ratchet is avoided. This device is made by the Vibration Proof Nut Company; the Niles Tool Works, 136 Liberty street, New York, agents.

# Letters from Practical Men

## Patterns for Crane Cheeks.

Editor American Machinist:

Professor Sweet's suggestion in your issue of April 13, relative to the side frame described on March 16, sets one thinking. Although conversant with crane work, I have not known a cheek of this type made in the way he suggests. Yet for heavy cranes it would be superior in several respects to the ribbed type. Conservatism has much to do with the retention of this form. But a boxed type would be costly by comparison. If a ribbed frame should be 1 or 1¼ inches in thickness, the boxed frame to take its place should not exceed from ⅜ to ⅝ inch, and the core would be of large area and of irregular form. This costs more money in the foundry than is usually spent on crane work. Still, we know how much can be expected by a good shop system, and it is probable that by the adoption of a suitable system and the standardizing of crane work to a much greater extent than it is yet done in England, the difference in cost might be reduced to nothing. Two great advantages would result from the adoption of the boxed framing. One is, that the winding of the castings, too common in these slender frames, would be nearly or entirely prevented; another, that the crane as a whole would be subject to less vibration and rattle due to the reciprocation of the engines and the surging of load than is the case at present. The extra cost of the core box work of course would count for nothing in well standardized cranes.

Although the boxed type of framing is not, so far as my experience goes, adopted in these tall or "vertical" cranes, it has been used for crab cheeks and for what are termed "horizontal" cranes. But in the latter the boxed cheeks are cast along with a bed which carries the engines and revolves. At some future time I shall be pleased to illustrate the making of this rather elaborate type of bed and cheeks.

JOSEPH HORNER.

Trenton-on-Avon, Bath, England.

## Making The Piston.

Editor American Machinist:

I notice a very interesting article by Mr. Baden in issue of March 16, in which he criticises my article of February 16, in regard to cost. Let us see by actual time if Mr. Baden is right. A pattern maker can make necessary core boxes or segments for either construction in one hour; there is no difference in the pattern room. This includes upset on cope and all necessary woodwork. The core maker can, and did, make six cores and black, inside only (Figs. 1 and 2) in 1½ hours. He also made six cores and blacked one side (Figs. 3 and 4) in three-quarters of an hour, which makes a total of 2¼ hours for the core maker. This time is for one man only, and is the actual time it took. Can a molder, by the use of segment and wings or ribs, as described by Mr. Baden, reduce the diameter and thickness in this time? No; and did Mr. Baden consult a molder in regard to which he would rather do, use cores or stop it off?

Where Mr. Baden takes it off the core department he puts more on to the molder,

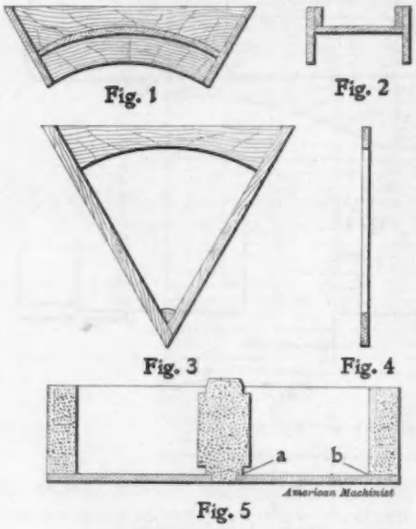



Fig. 5

MAKING THE PISTON.

which I know is not appreciated by him. Mr. Baden makes the statement that the molder can stop it off in one hour. I would like to ask if he did not forget to add the "s" on "molder," as we all know no one molder can stop 12 inches deep and 4 inches thick six times in one hour, and do it as it should be done. After the segments have been rammed up, he has got to draw up either the segment and ribs or unscrew ribs and draw segment up, as it cannot be drawn in to the center. A molder and helper can set all the cores in one hour, and do it right. The cores are fastened by the cores themselves, as shown in Fig. 5, *a* and *b*. The center core holds the inside, while the segment cores hold the outside.

I think it is a grand, good idea to criticise and discuss, and it shows to us the different ways of construction that can be used.

G. H. WILLARD.

Worcester, Mass.

## How to Pay Off.

Editor American Machinist:

What is the best way to pay off a thousand men, paying them every Saturday afternoon? This is not a very big question, but it is one worth the asking, and I venture to ask it because I was asked the same. I happen to know a machine concern which has had quite a phenomenal growth, and which is still growing, but which has some of the traditions and habits of the little shop still clinging to it. When a man has not more than half a dozen hands, it is natural enough to go around the shop and hand each his wad a little before quitting time; but it is quite different with a thousand men in eight or ten different departments. Yet this practice of carrying it around is still followed in the works to which I refer. Last week the pay roll was $10,000, and two men carried the pay envelopes in open drawers and hunted up each individual man all through the establishment. It is a risky, inconvenient and laborious operation, and as there could no well be a worse arrangement there should be a much better one.

MORRIS FULTON.

## Pile-Driver Progress.

Editor American Machinist:

An improvement that more than doubles the efficiency of an important machine, that makes it do more than double the work in a given time, is really a noteworthy thing, and something that we don't run across every day. There is generally considerable fuss made over such a thing as that, and the fellow who does it generally gets some credit and notoriety, if he doesn't also get, as he should, a pile of money for it. Well, such an improvement has occurred easily within my memory and observation, and I don't know that the attention of the mechanical world has ever been drawn to it. I certainly have never seen any allusion to it, and I have not the slightest idea who first did it, but he did a big thing, such a thing as it comes to few to do in a lifetime.

The thing that I mean here is the improvement in running pile-drivers. I like to watch a pile-driver at work, and at different times, when I have found them in my wanderings, I have spent considerable time in the occupation, so that I have become—to myself—quite an authority upon the running of pile-drivers. It is very certain that a pile-driver now works much more than double as fast, or does per day much more than double the work, that one of them used to do. And it's the simplest thing in the world. It comes from not unhitching the ram for the drop. They used to hoist the ram to the hight that they decided to work at, and then it was automatically unhitched by striking a dog, or it could also be unhitched from below by a lever; but, either way, there was the delay of lowering and hitching on again for each drop. I don't see them do that any more anywhere. There is no unhitching, but the drum is unclutched and allowed to run back, and as soon as the blow is struck, the slack is taken up and the ram begins to go up at once. Of course friction clutches are used, and a brake for the drum, but they work quite smoothly and seem to wear well, so that there is nothing more liable to derangement and requiring constant repairs under the present arrangement than under the old.

Of course it is evident that there is a

great saving of time by not unhitching, and the object lesson of seeing the thing at work is much stronger than the telling of it. Time is saved not only for the runner, but for the entire gang, usually not less than five, employed about the pile-driver. I suppose that many persons who can't help seeing the great gain in time that is accomplished by this simple change in the mode of operating will just let it go at that, and think that they see all the good of it at once. But there is really considerable more in it than this. The engine in this work, it will be noticed, does not stop, and, indeed, runs faster when the drop occurs, and all the momentum which it thus acquires is precisely what is required for starting the weight and for quickly getting it up to speed. Not only is the time between the release of the weight for the drop and the beginning of the next lift reduced to less than a quarter of the time formerly required, but the actual lifting time after the lifting begins is appreciably reduced. And on account of the momentum of the fly-wheel, which is thus made fully available, a smaller engine is really sufficient for the work than was required in the old time when it was used to start the lift by dead pull from absolute rest. This continuous running of the engine, and the value of it as a working feature, is worthy of the serious attention of those who are working upon automobile and autotruck problems. It is quite desirable to start the vehicle and to get it up to speed as quickly as possible, and to do this all the schemes call for motors of much higher power than is needed for the continuous running after the required speed is attained. The gasoline and oil engines are better to be kept continuously running, and generally they are in the habit of insisting upon being kept running, as they don't stop and start as easily and promptly as a steam engine; but this always keeping running, with also the heavy fly-wheels that they usually carry, may be really the most valuable feature about them for automobile service.

The increased frequency with which the blows can now be delivered on the head of the pile makes quite a difference in the movement of the pile per blow. Rapidity of blow keeps the ground around the pile from resettling to close contact, so that the quicker the blows succeed each other the more effective is each individual blow. This is much better exemplified in the work of the gunpowder pile-driver, one of which I had the pleasure of watching some years ago. An iron cap is placed on the top of the pile, with a cavity in which is placed a cartridge of powder. On the under side of the weight or ram, and forming a part of it, is a plunger which easily enters the cartridge cavity. The ram is first hoisted to the required hight, and then dropped as usual. The force of the blow comes first upon the powder, but is of course, as usual, transmitted to the pile, and overcomes its inertia and starts it downward, as any other blow would do; but while the pile is thus moving the powder explodes, with a force sufficient to throw the weight up to the same hight as that from which it dropped, where it is caught and held by an automatic friction dog. While the force of the falling blow gets the pile under headway and drives it a certain distance downward, the force of the explosion, which is not less, but a little more than that of the drop, is all expended in keeping the pile moving after it has started, so that the actual movement caused by the explosion is greater than that caused by the drop. As these blows and explosions have sometimes been continued at a rate of from thirty to forty per minute, they have shown the most effective pile-driving upon record.

I notice that the pile-drivers have also learned the lesson that the machinist learned long ago, and that is, the difference between the effect of the quick blow of the light hammer and that of the slower blow of the heavier hammer, even when the foot-pounds of the two figure out the same. Of course the latter is much more effective in driving, and less damaging to the top of the pile than the other. So we now see in use heavier weights with shorter drops. It looks something like a waste of time to see them pounding away now with drops of 6 or 8 feet, where they once used 20 or 30 feet, but it is evidently the better way. The drag of the hoisting rope when the weight drops must retard the movement of the weight a little, but this is all fully compensated for by a few inches of additional lift.

TECUMSEH SWIFT.

## Foreign News Notes.

The Mexican Government has concluded concessions and contracts for various railways through her neighboring State of Yucatan. These concessions cover a line from Peto to the Bay of Espiritu Santo, and a branch to Ascension; from Valladolid to a point on the line for Peto; from a point on the Peto Line to the banks of the Hondo, which is on the frontier of British Honduras. These lines must be begun within two years, and are to have a gage of 914 milimeters.

Ninety per cent. of the trade in sporting guns in Egypt is in the hands of Belgian manufacturers.

Among the many improvements that are being made and are under contemplation in Formosa will be the improvement of the docks and harbors and the extension of the railway. All of this will mean the need of dredgers, rails, locomotives, etc., all of which have to be purchased in the foreign market. But the larger proportion of these supplies will be supplied through the Japanese Government, and the bids for them will be made in Tokio.

There is a movement on foot to extend the electric railways in Cape Town and Port Elizabeth, both of which are American plants. An electric plant is also to be installed in the near future at Queenstown.

There is a market in Servia for beaten iron plates, which are chiefly supplied by Hungary. They are shipped in packages of 25 kilograms in weight, the number of sheets per bundle varying from one to fifty. To effect sales it would be necessary to have an agent who could be entrusted with samples, as they will not buy sight unseen.

Germany, so often our competitor, is stated to be an open market for the introduction of good machinery to crush stone. All the principal roads in Germany are made of stone, all of which is at the present time broken by hammers, and an American steam stone crusher would do wonders if it could be set up in one of the immense stone quarries to be found all over Germany.

An English syndicate has purchased the works of the American Screw Company, at Leeds, and work is proceeding without interruption.

A. F. T.

## Questions and Answers.

*Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.*

(55) J. D., Lehi, Utah, writes: Can you give me a simple way of bending 3-inch boiler tubes without kinking them? I have a number of coils to make about 6 feet long and 2½ feet wide, and find they kink in bending. I have made a number of 2-inch tubes filled with lead, which worked well, but with 3-inch pipe it does not work. A.—Sometimes it works well to fill such pipes tightly with dry sand and then heat them for the bending.

(56) A. D., Glasgow, Scotland, writes: What is the cheapest method of finding the outside diameter of a milling cutter when the teeth are cut spirally and when the pitch and number of teeth are given? When the teeth are cut straight it is quite simple, but when cut with a spiral I find the difficulty. A.—By the term pitch, as you use it, we understand you to mean the shortest distance between two contiguous teeth, or what would be called the normal pitch of the teeth, and the diameter of such a cutter is found by multiplying the number of teeth by the normal pitch, this product by the secant of the angle of the spiral, and dividing by 3.1416. This may be expressed in the shape of a formula, as follows:

$$\frac{n\ p\ \sec.\ a}{3.1416}$$

The angle here meant is the angle between the spiral or helix and the center line of the cutter, and is the same as the angle subtended between a line drawn at right angles to the axis, and one on which the normal pitch is measured.

## Personal.

Mr. Alfred P. Sloan, Jr., has been appointed general manager of the Hyatt Roller Bearing Company, Harrison, N. J.

Mr. C. M. Conradson has been charged with the selection of the tools for the plant of the New York Shipbuilding Company, and is for a time in the East engaged in that work.

Mr. Henry M. Crouse, who is making a specialty of the preparation of machinery catalogs, and has recently been at work in New York, is now with the American Tool Works Company, Cincinnati, Ohio.

Mr. W. G. Holmes, who until recently was superintendent and manager of the Boston Blower Company, has accepted the position of general superintendent of the New York Blower Company's shops at Bucyrus, Ohio.

Adolphe Janssens, of Paris, informs us by cable that he expects to sail for this country by the "Lucania" on Saturday, 20th, and mail may be addressed to him at the office of this journal. He will be due here about the 26th.

## Obituary.

Charles L. Hill, president of the Bridgeport (Conn.) Chain Company, died in Brooklyn, May 21; sixty-two years old.

James P. Crawford, president of the Terre Haute Iron & Steel Company and secretary of the Wabash Iron Company, also of Terre Haute, died in this city May 12, forty-four years old.

Harry E. Billings, of Hartford, son of Chas. E. Billings and assistant superintendent of the Billings & Spencer establishment, was drowned at Hartford recently. He was about thirty years of age.

David L. Bartlett, founder and senior member of the firm of Bartlett, Hayward & Co., Baltimore, Md., died in that city May 11, eighty-three years old. He was born in Hadley, Mass., and was first a molder in Hartford, Conn. He started a foundry in Baltimore in 1844. In 1850 the business with which he was identified for the remainder of his life was begun. The firm now employs 500 men.

## Technical Publications.

"Wright's Trade Directory and Gazetteer." 3,716 6x9-inch pages Cloth, $10. George Wright, 121 Fulton street, New York.

This is a classified business and trade directory of Australia, India, China, Japan, Canada, South and Central America, West Indies and South Africa. The different sections of the book are distinguished by the use of various colored paper, and the names of the various countries being printed upon the edges of the leaves it is easy to turn to any desired section. The various cities and towns are arranged alphabetically in each section, and under the city or town name are entered in classified alphabetical order lists of the various business and manufacturing concerns. In connection with our growing export trade we should consider this directory to be a valuable one. It is the fifth edition, and is now about twice as large as the first. The fourth edition was issued five years ago, since which time many changes have of course taken place.

Through the courtesy of Mr. E. D. Meier, chairman of the committee, we have received a copy of "Uniform American Boiler Specifications," adopted by the American Boiler Manufacturers' Association at the St. Louis meeting, held in 1898. Those who are interested in boiler construction would do well to have a copy of these specifications, which are supposed to control the practice of the members of the association named.

The Rogers & Hubbard Company, of Middletown, Conn., have issued a second edition of their pamphlet "How to Case-Harden, Color and Anneal With Granulated Raw Bone." Before issuing this they took council with a number of manufacturers doing large amounts of case-hardening, and have thus gathered many of the latest ideas, and among other

(*Continued on page 39.*)

# Miscellaneous Wants.

*Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer. Mach. T. Co., Meriden, Ct.

The Dutton Wet Twist Drill Grinder is sold by the Garvin Machine Co., New York City.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," price $1, post paid. J. L. Lucas, Prov., R. I. Send for index sheet.

Large stock of new Tabor governors, 70 p. c. discount. McSwegan, Dover st., N. Y. City.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 88 Cortlandt st., New York.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. (postal order) by G. W. Dixon, Spring Lake, Mich.

The Waltham Machine Works, Waltham, Mass., make a specialty of accurate work. Correspondence in regard to small automatic machinery, punches and dies, etc., is solicited.

Institutions retiring from business having machine tools, brass or wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

For Sale—A modern equipped machine shop and foundry, employing 35 hands, in a thriving city containing 40,000 inhabitants, a prominent railroad center in the State of New York; a good chance for two or three practical mechanics to invest and secure a good business; no local competition; reason for selling, ill health. Box 338, AM. MACH.

The designer and patentee of a machine tool that can be seen in practical operation and that has novel and valuable features, wishes to interest someone with capital in search of a business in which he will take an active part, or would place in an established machine shop on a royalty basis. Box 332, AMERICAN MACHINIST.

# Wants.

*Situations and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.*

## Situations Wanted.

Mechanical draftsman wishes position; excellent references. Box 335, AMER. MACH.

Technical mechanical draftsman, 5 years' experience. Box 340, AMERICAN MACHINIST.

Situation wanted by a first-class pattern-maker. Address Box 331, AMER. MACHINIST.

Tool-maker desires situation; tools, jigs, dies, die-sinking, etc.; fine work only. Box 347, AMERICAN MACHINIST.

Wanted—Situation; competent mechanical draftsman; detail work preferred; references. Box 350, AMERICAN MACHINIST.

Wanted—Position as foreman of jobbing machine shop; best of references; long experience. Address Box 342, AMER. MACH.

First-class, experienced pattern-maker desires a change; steady position preferred and located in the East. Box 330, AMER. MACH.

As superintendent, master mechanic or representative abroad, by expert mechanical engineer; highest references. Box 345, AMERICAN MACHINIST.

Machinist and technical graduate desires position in machine shop or with manufacturing company; chance for promotion. Box 348, AMERICAN MACHINIST.

Mechanical engineer and designer with practical shop experience, in charge of drawing room the last 7 years, desires situation. Box 311, AMERICAN MACHINIST.

Mechanical draftsman is open for engagement; now employed; 10 years' experience on medium and light machinery, jigs and fixtures. Box 343, AMERICAN MACHINIST.

Mechanical draftsman, having 6 years' experience and a finished technical college education, desires a change; best of references. Address Box 351, AMERICAN MACHINIST.

An expert cost accountant and shop systemizer is open to a long or short engagement; can check losses and increase gains; write me. Box 305, AMERICAN MACHINIST.

Middle-aged designing draftsman, familiar with the manufacture of builders' hardware, bicycles, stamping machinery, registers, etc., wants a position. Box 336, AMER. MACH.

Machine foreman, 13 years' experience on heavy eng. work and general machinery; good handler of men and capable of getting out lots of work; at present employed. Box 339, AMERICAN MACHINIST.

A man who can devise ways of reducing cost of manufacturing hardware specialties or light machinery, wants employment as draftsman or assistant superintendent. Box 337, AMERICAN MACHINIST.

Machinist, experienced in tool work, speaking German, French and English (resident of Paris for two years), would like to take charge of machine exhibit at Paris Exposition. Box 344, AMERICAN MACHINIST.

Technical graduate of an American institute and first-class tool-maker, familiar with English, French and German, wishes to take a reliable engagement for the Paris Exposition. Box 349, AMERICAN MACHINIST.

Special and automatic machinery (my specialty) designer wants to change; inventions developed; was machinist 9 years, draftsman 6 years; American, age 29, with talent; excellent references; East preferred. Address Box 322, AMERICAN MACHINIST.

## Help Wanted.

Wanted—Draftsman with experience in machine-tool building, for shop near Chicago. Address Box 294, AMERICAN MACHINIST.

Wanted—Man with experience on Gisholt turret lathe; state experience and wages expected. Box 323, AMERICAN MACHINIST.

Wanted—Good, all-round machinists on new and repair work; state age, experience and wages expected. Beall Machine Works, Cumberland, Md.

Draftsman, accustomed to printing-press work and designing new machinery. Address,

stating experience and salary expected, Box 346, AMERICAN MACHINIST.

Wanted—Foreman or assistant superintendent familiar with the construction of gasoline engines. Reply at once to Box 392, Toronto Junction, Ontario, stating experience and salary.

Wanted—Mechanical draftsman, familiar with Corliss engine work; state training, experience, age and salary expected; also give references. The Bass Foundry & Machine Co., Fort Wayne, Ind.

Wanted—A first-class mechanical draftsman, thoroughly familiar with shop drawings and the designing of general machinery; a permanent position for proper man. Address, with full particulars as to experience, salary and references, Box 341, AM. MACH.

Wanted—Foreman, by an old, reliable firm in the steam fittings and brass goods line in the center of Germany, for brass foundry employing about 70 men; knowledge of German language required; state experience, age and wages expected. Box 335, AMER. MACHINIST.

Superintendent Wanted — Superintendent for manufactory building steam engines and employing 500 men; must be familiar with modern shop methods; good salary to right man; state experience; give references. Address Box 316, AMERICAN MACHINIST.

Machinery Salesman—By a large export firm, a man to sell American machinery in Europe; must be a thorough mechanic, conversant with a general line of machine tools, and with ability to solicit orders understandingly; must have a thorough knowledge of German. Address "Export Salesman," AMERICAN MACHINIST.

Wanted—A thoroughly practical and experienced draftsman and tool-maker who is capable of designing and making tools and jigs to turn out a piece of mechanism on the lines of a watch made of brass in the most modern and economical way; state age, experience and salary demanded. Box 333, AMERICAN MACHINIST.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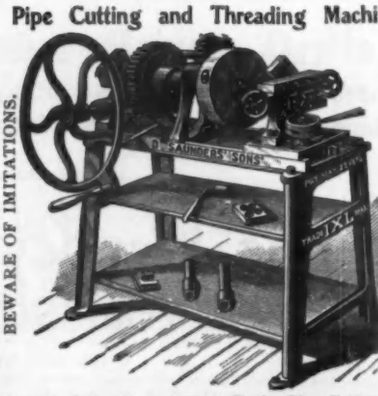


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(*Continued from page 38.*)

things is the method of drawing to different colors case-hardened articles, the same as though made of carbon steel; method of annealing low carbon bars without carbonizing the surfaces, etc. Certainly no one who case-hardens can afford to be without the book, especially as it is sent free by addressing the company as above.

"Modern Cycle Repairs." Name of author not given. Published by The Cycle Age Company, Chicago. 130 6x9-inch pages. 111 illustrations. Cloth, $2.

This is an excellent example of what can be done in the way of technical book making by one who knows his subject and also knows how to write about it. Mechanically, and from the business point of view as well, the book is sound, clear and in every way excellent. No bicycle repairman can afford to be without it.

## The World's Mineral Producers.

Great Britain mines more coal than any other country, but the United States, with a constantly increasing output, already crowds her closely. The United States produces 223,000 tons of copper annually, which is more than one-half of the total product of the world. The South African Republic this year supersedes our country as the greatest producer of gold. In the production of iron the United States leads, followed in order by Great Britain, Germany, Luxemburg, France, Austria, Hungary and Sweden. Russia and the United States supply all the world with petroleum. In the production of silver the United States comes first, with Mexico next, and then Australasia, Bolivia and Germany. The tin of the world comes mainly from the Malay peninsula, and zinc is produced most extensively in Upper Silesia, the United States standing second.

During a discussion in the British House of Commons recently as to the advantages of automatic couplers for trains, a Mr. Maddicon stated that from 1888 to 1897, a period of ten years, 4,757 railway employees in the United Kingdom lost their lives in coupling cars. In 1897 an average of one brakeman in 274 was killed. Mr. Burns supplemented these figures with the somewhat astonishing statement that in twenty-five years, from 1872 to 1897, among 1,500,000 English soldiers 1,396 were killed in battle, while for the same period, 9,000 railway employees were killed.

The United States Civil Service Commission announces that applicants for the position of inspector of standards, United States Geodetic Survey, at a salary of $3,000 per annum, will be permitted to file their applications as late as July 15, instead of June 1, as heretofore an-

nounced. Application blanks may be obtained by addressing the Commission at Washington, D. C.

Among the changes taking place among Cincinnati tool builders it is noticeable that some of the contracting shops that have been building tools for the American Tool Works Company have discontinued and have gone into business for themselves. Others it is understood will do so before long.

The Hoggson & Pettis Manufacturing Company, New Haven Conn., have brought out a new style of jaw for scroll chucks, the teeth on this jaw being arranged to fit the threads of the scroll either way, so that the jaw is reversible, which we believe is a new feature in scroll chucks.

## Manufacturers.

Crawly & Johnson, of Cincinnati, Ohio, have just received a permit to erect a new factory at 320 Main street, that city.

Pawling & Harnischfeger, Milwaukee, Wis., are to erect a new factory building on Oregon street, in the city referred to.

The Olympia Cotton Mills, of Columbia, S. C., has recently asked for a charter. The capital of the concern is $1,500,000.

Chas. A. Stickney, of Minneapolis, Minn., is to erect a plant in which to manufacture gas engines. The building is to be 50x150 feet, and two stories high.

The Hisey Machine Works, of Aurora, Ind., have given up the manufacture of special machinery to engage in the making of a line of milling machines, which machines embody new features.

The saw-mill and lumber yard at the foot of Pearl street, Camden, N. J., owned by the A. W. Patchin estate, was sold recently to capitalists, who, it is said, propose to invest about $150,000 in the plant and convert it into a hardwood saw-mill.

The Weedsport (Pa.) Electric Light & Power Company has started the erection of a new power house on the site of the old one. It will be a two-story brick building with offices on the top floors. Entirely new machinery will be placed in the new building.

William O. Dorsey, of Terre Haute, Ind., president of the new corporation formed by about 150 pavement and road contractors, which is to erect a factory for the manufacture of material because the trust has raised prices, says it has been decided to locate the factory in Brazil, Ind.

The Milwaukee (Wis.) Harvester Company has purchased twelve acres of land in the Menomonee valley, between Fourteenth and Sixteenth avenues, on the extension of Park street, on which the Harvester Company will build several additions to its manufacturing plant. The company intends, during the coming summer, to erect several factory buildings on this additional site, which will cost about $100,000 more.

J. E. Platt, who was proprietor of the Eagle Rice Mill, Crowley, La., which burned with all machinery and a large quantity of rice some time ago, entailing a loss of $80,000, has decided to rebuild, and he closed a contract recently with the Boland & Gschwind Company, Limited, of New Orleans, through their representative, Phil Hoelzel, Jr., for the

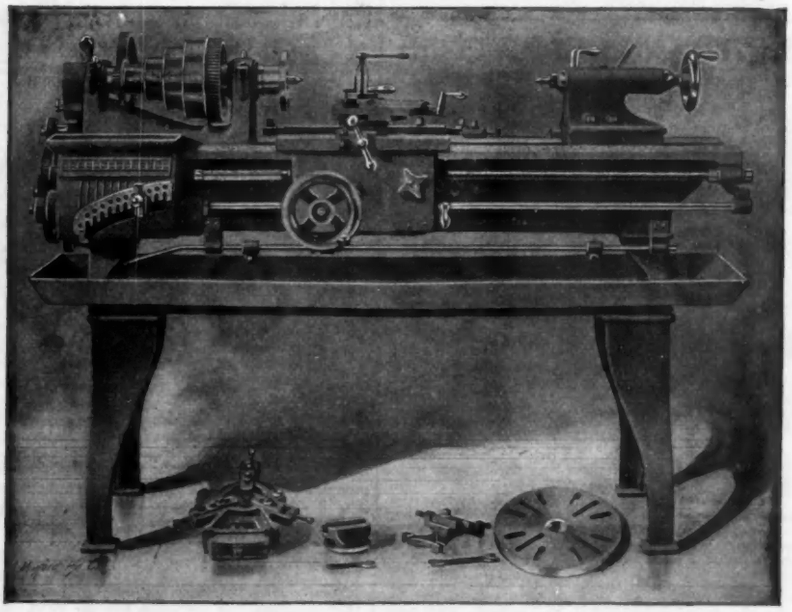
(*Continued on page* 41.)


# The Hendey Machine Co.

## TORRINGTON, CONN.

This Company is the sole owner of Letters Patents Nos. 468,183, 470,591, 519,294, 549,006 and 557,031, granted to P. & W. Schellenbach, W. P. Norton, and W. L. Schellenbach, for Improvements in Engine Lathes.

We take this method of notifying the public that we have already commenced suit against infringers of these patents, and that should it be found necessary to the protection of our rights, additional suits will be brought against manufacturers, vendors and users of infringing lathes.



The merits of these improvements have been widely recognized and have been wantonly copied. We shall take vigorous steps to protect our own.

# The Hendey Machine Co.,

## TORRINGTON, CONN.

**UNITED STATES AGENTS:**

Hill, Clarke & Co., Boston. Manning, Maxwell & Moore and The Garvin Machine Co., New York. J. W. Cregar, Philadelphia. U. Baird Machinery Co., Pittsburgh. The E. A. Kinsey Co., Cincinnati. Manning, Maxwell & Moore, Chicago. Pacific Tool & Supply Co., San Francisco.

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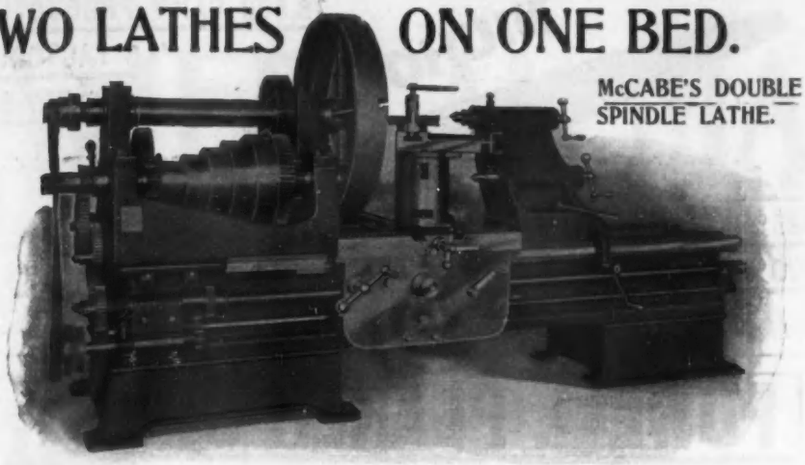
# TWO LATHES ON ONE BED.



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Other interesting particulars on request.

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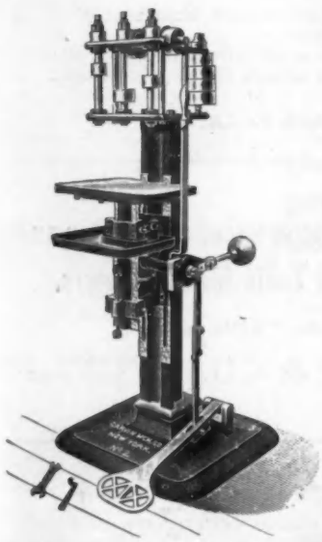

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(*Continued from page 40.*)

erection of a 400-barrel rice mill. Work will commence at once on the building, and will be pushed as rapidly as possible. It is expected that the building will be ready for the machinery in from thirty to forty-five days.

The Boston Blower Company has been absorbed by the B. F. Sturtevant Company, and Mr. W. G. Holmes, who was superintendent and manager of the first named company will now be general superintendent of the shops at Bucyrus, Ohio, of a new company to be called the New York Blower Company, which will engage in the manufacture of blowers, heating, ventilating and drying apparatus, exhausters, etc. The New York offices of this company will be at 39-41 Cortlandt street, and will be in charge of Mr. D. T. Lyon, general manager, Mr. Lyon having formerly been New York representative of the Boston Blower Company.

A new electrical manufacturing company has recently been formed at Milwaukee, Wis., under the title of the Milwaukee Electric Company, with a nominal capital of $40,000. The company will make a specialty of motors for all purposes, giving special attention to their direct adaptation to machine tools of every description. They will also manufacture lighing and power dynamos and other electric appliances. The officers of the company are: W. P. Harper, president; Walter Cary, secretary; J. L. Marshall, superintendent; J. A. Whaling, treasurer, and H. W. Morris, secretary. Among the directors are J. W. Suetterlee, of the firm of Leffelhols & Co., and A. B. Stetson, general manager of the Bucyrus Steam Shovel & Dredge Company. The works are being rapidly equipped with modern machine tools. The motive power will be furnished by a 75 horse-power Reynolds Corliss engine.

## New Catalogs.

The Almstead Company, of Bridgeport, Conn., has forwarded copy of catalog illustrating and describing chemical fire extinguishing apparatus. The catalog is 5¾x7¾ inches.

Curtis & Curtis, Bridgeport, Conn., have sent us copy of their 1899 catalog, which is devoted to the illustration and description of the Forbes die stock, pipe cutting and threading machinery, ratchet drills, pipe wrenches, etc. The catalog is 8¼x9½ inches.

We have received from Dreses, Mueller & Co., Cincinnati, O., their catalog of radial drills. The various features of these tools are described in detail, showing in what points they differ from other machines of this class. The catalog is standard size, 6x9 inches.

We have just received from the Chicago Pneumatic Tool Company, Chicago, Ill., catalog No. 6 of pneumatic tools, including air drills, flue welders, riveters, hammers, etc. Each of these tools is illustrated and illustrations showing them in use are given. The catalog is copiously illustrated, is standard size, 6x9 inches, and contains 100 pages.

The Olds Gasoline Engine Works, Lansing, Mich., have sent us catalog illustrating and describing gas and gasoline engines which are used for motor carriages, stationary purposes and also for marine propulsion. The catalog contains illustrations of various departments of the works in which these engines are constructed. The catalog is standard size, 6x9 inches.

The Engineering & Power Company, 169


**Iron Working Machinery, For Immediate Delivery.** **W. R. Colcord Machinery Co.,** 423-425 N. SECOND ST., ST. LOUIS, MO.

Broadway, New York, has sent us copy of catalog in which are illustrated and described indicators, planimeters, separators, exhaust heads and other devices used by those engaged in the installation and care of steam plants. The various appliances shown are described in detail. The catalog is 6x9¼ inches.

The Turner, Vaughn & Taylor Company, Cuyahoga Falls, O., have sent us catalog No. 35 of wire and chain machinery. The catalog is illustrated and contains a number of tables which should interest those engaged in the manufacture of wire articles and chains. The catalog also contains illustrations of clayworking and potters' machinery which is made by the same company. Catalog is 8x10¾ inches.

We have received from the Baldwin Locomotive Works, Philadelphia, Pa., No. 12 of "Record of Recent Construction" series. In it are illustrations of a number of different styles of locomotives recently constructed by the company referred to and destined for various countries. Specifications of these engines are also included, these being given in French as well as English. The pamphlet is standard size 6x9 inches.

The Department of Engineering of the University of Michigan, Ann Arbor, Mich., has issued its catalog for 1899-1900. This contains general information regarding the situation of the university, qualifications for admission, courses of instruction, etc. The various laboratories and shops are described in detail. The catalog also contains a register of alumni from the year 1860 up to last year. The catalog is 4¾x7¼ inches.

We have received from the American Turret Lathe Works Company, Cincinnati, O., catalog describing their semi-automatic turret lathes designed specially for rapidly and accurately finishing castings. These lathes are built in three sizes to swing 24, 30 and 40 inches. Plans and elevations showing the old and new construction of a number of the parts of the machines are included. The catalog measures 6x9¼ inches.

The International Express Company, of 52 Broadway, New York, has issued a chart showing the lines traveled by ships engaged in the commerce of the world. This chart, which was originally prepared by the hydrographic office of the United States Navy Department, should be of great utility, especially in those businesses in which the sending and receiving of merchandise are carried on. Copies of this chart, mounted, can be supplied for 50 cents, and unmounted for 25 cents.

We have received from the Clayton Air-Compressor Works, New York, N. Y., copy of complete catalog No. 10, in which are illustrated and described air compressors of practically every type, gas compressors, compressed air tools and appliances. The catalog contains seventy 6¼x9¼-inch pages, and in addition to purely advertising matter, there will be found some useful data regarding efficiency of air compressors at high altitudes. We are informed that a copy will be sent gratis to those who apply.

The Crocker-Wheeler Electric Company sends us copy of Bulletin No. 8, in which are described and illustrated motors adapted for special work. These include mill elevator, brake and shop motors. The distinguishing features of these motors are their exceptional operating characteristics, protective forms and controlling mechanisms, making them especially desirable for work that requires either great momentary turning, safety from external injury or convenient starting and stopping. The controllers used with these motors are also described. The catalog is 7½x10 inches.


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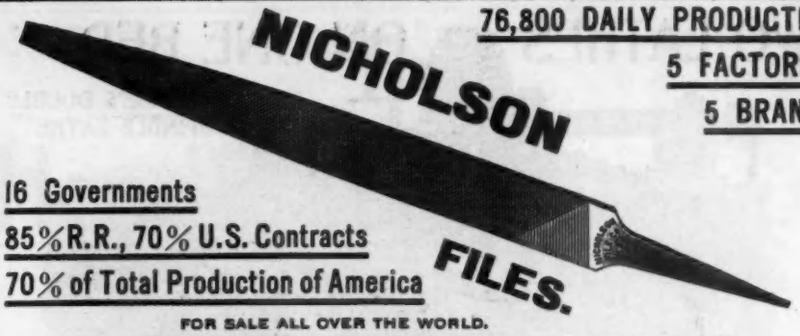


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